FARM MANAGEMENT

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Authors' Preface

THIS TEXTBOOK IS INTENDED PRIMARILY FOR USE IN THE JUNIOR AND senior years in agricultural colleges. It is intended also to provide the materials for a substantial course on the same level of intellectual maturity as the usual courses in Feeds and Feeding, Soils, Genetics and the like, and to be preceded by the first two especially, and to build upon them. It also assumes that the student will have had an elementary course in the Principles of Economics, or the more or less equivalent course given instead in some colleges of agriculture. The content of the beginning course in economics taken by agricultural college students varies so much, however, that it has been necessary to restate some of the principles in order to be sure that all readers will be equipped with those that are basic to Farm Management. This is particularly true of the principles of production economics, usually inadequately developed in elementary textbooks in economics. Classes which have already studied these principles thoroughly in other courses need use some sections of this book only as review.

The materials included, and accompanying exercises, are believed to be adequate for a two-term or three-quarter course. But a shorter course can easily be arranged by omitting chapters and exercises. The authors believe that every graduate of an agricultural college, no matter what line of agricultural activity he subsequently undertakes, needs a substantial year course in Farm Management. Nothing short of a year course will provide the needed integration, and conversion to an operating-farm basis, of what he learns in his other courses. Part of this integration may be provided in other required courses in the economics of agriculture, but usually it is not.

A deliberate effort has also been made to provide a textbook which is suited to the teaching of Farm Management in all parts of the United States. One of the authors knows best the farming of the Northeast; another, that of the South; another, that of the Midwest; and the other, that of the Great Plains and beyond. Each has made his particular contribution to the chapters and parts of chapters dealing with the farming

of his region. The senior author also performed the task of fitting together the analyses for the different regions and unifying the methods and treatment. He was helped in doing this by research which he had conducted or directed in ten of the states, in the Midwest and New England mostly, and by nine months of reconnaissance study in the South and West in 1941, under a grant from the Rockefeller Foundation.

It is expected, however, that courses based on this textbook will adapt it more or less to the farming of the particular region: first, by working more intensively the chapters and parts of chapters that deal with the farming of that region, and in particular, making fuller use of the exercises accompanying these chapters; and second, by supplementing the materials in the textbook by materials drawn from studies made in the region, and by special exercises based upon these studies. A suggested list of supplementary readings accompanies each chapter. (The footnotes and supplementary readings marked with a star (*) are intended primarily for regular students in the course, and the others for teachers and advanced students.) The authors believe that every agricultural college graduate should know at least as much about the agriculture of other parts of the United States as is presented in this book, and that the course in Farm Management should be long enough to cover at least in a superficial way all the chapters in the book. If the course is too brief for this, chapters in Part Five are most easily omitted.

The exercises at the ends of the chapters in Parts One to Four are intended only to suggest the form which such exercises should take. It is expected that the instructor will adapt them to his class and to the agriculture of his area and region. By their character, they point to the need that every student carry through the different analyses outlined by applying them to at least one farm, preferably the one he already knows best. Class discussion of the results of such analyses of different farms and of the problems arising in such analyses will add greatly to the effectiveness of the instruction. A good course in farm management needs to be accompanied by some laboratory and field work.

The outstanding characteristic of the treatment of Farm Management in this textbook is that the analysis is in terms of the *farm as a whole*. The economics presented is the *economics of the farm as a firm*, as this terminology has come to be used in recent economic literature. The main principles are presented in Part Two in terms of their exemplification, or working out, in actual operating farm units, or in the actual farming systems that prevail in areas or regions. They are more generalized in Parts Three and Four, but even here they are presented in concrete and specific settings. The pedagogical maxim observed is that the principle and its

application need to be taught at the same time if the principle is to be meaningful, and more important, helpful in later years. Many accept this maxim, but fail really to follow it. Others who follow it fail to present enough of the setting so that the student gets the total picture. Few changes in a farm organization can be made that do not affect all parts of it more or less. The farm business must therefore be looked at as a whole. The final test of any change under consideration is its effect on the real net income of the farm or farm family as a whole.

No rules for successful farming are laid down in this book. Instead, an attempt is made to provide a method of analysis that a farmer can apply to a situation of his own that will indicate the best course for him to follow. The methods of analysis presented are simple, direct, concrete, and highly realistic. They are, in fact, the methods naturally followed by practical hard-headed farmers who take the trouble to analyze their management problems. Yet these methods are shown to be consistent with, and give answers that are consistent with, the highest order of economic thinking.

Farm Management is applied Science — not just applied Economics, but also applied Biology, Physics, Chemistry, Geology, Meteorology, Psychology and even Sociology. This means that the farm manager must join economics with these sciences, and with such other applied sciences as Agronomy, Animal Nutrition, Genetics, Plant Pathology, etc., in arriving at answers to his management questions. A course in Farm Management must therefore train students in the ways and means of doing this joining. Chapter by chapter, and almost page by page, the reader of this book, especially from Chapter 7 on, will find himself engaged in such activity.

Part One, and the final chapter, are intended to orient the student of Farm Management in this country this year in this world of place and time — first, in his own little world of farm and family; then in the vastly larger social group, the nation; and finally in the affairs of nations from which no enterprise can isolate itself today. The students of this generation have immeasurably widened their horizons. Many of them have seen farming vastly different from what they had known before. They ask why it is so different. They ask to see the farming they have known in a larger perspective.

ACKNOWLEDGMENTS

Foremost of all, the authors must acknowledge their indebtedness to the large volume of past research done by workers in the state agricultural experiment stations and in the United States Department of Agriculture. Without the concrete results of this research, the principles of farm management presented in this book would be merely wraiths floating in the air over the surface of our agriculture. The research in agronomy, animal and dairy husbandry, soils, genetics and plant pathology has helped fully as much to make this book meaningful as has that in farm management. Specific acknowledgment in footnote references has been made wherever possible; but the results of this research have become so much a part of the background of knowledge of the authors that they are no longer able in many cases to name the origins. The references cited are mainly to recent publications that have been used directly in the writing.

Specific appreciation should be expressed to Henry A. Wallace who as Secretary of Agriculture made possible the joint projects between the Department of Agriculture and two groups of state experiment stations, without which large parts of Chapters 9, 16 and 17, and important sections of other chapters, could not have been written. When Congress assigned one fifth of the Bankhead-Jones research funds to the Department of Agriculture to be used on research in the sciences fundamental to agriculture, Secretary Wallace asked the Social Science Research Council to suggest research in the economics of agriculture that would meet this specification. The Council proposed projects relating to two of the basic economic principles of farm management, input-output relations, and the location of production and combination of farm enterprises.

Particular credit needs also to be given to several score of workers in the states and in the Department of Agriculture, the TVA, and other agencies, who have helped in the writing of this book either by supplying materials or illustrative data or by reading particular chapters or parts of chapters. To have named all of these individuals would have loaded down the book with too many footnotes. The manuscript of the whole book was read at various stages by Dr. Sherman Johnson of the Division of Farm Management and Costs and some of his associates, particularly Neil Johnson, and by Dr. Charles E. Kellogg of the Bureau of Plant Industry, with some help from his associates. Space was not available for developing all of their many valuable suggestions.

Finally, thanks must be given to the members of the staff of the

Division of Public Information who have been so helpful in supplying the charts and photographs used.

The authors also wish to acknowledge their indebtedness to Dr. Phillip E. Jones of the Bureau of Agricultural Economics for free use of the information and analysis in his unpublished study, *Needed Adjustment in the Cotton Economy of the Southeastern United States*.

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Part One

INTRODUCTION

CHAPTER I

The Farm Management Function

TO MANAGE A FARM BUSINESS MEANS TO ORGANIZE IT, TO PLAN THE work and direct it from day to day, and to plan, and on most farms actually conduct, the buying and selling and the financing or credit operations. Organizing a farm business, however, is not something which is done once and for all. Part of it has to be done over again at the beginning of each new planting or breeding season. An unusual growing season, or a shift in market demand brought on by a war or a depression, may call for some reorganization even within the year.

Most farms are too small to afford a manager who does nothing but manage. In the United States, only one farmer in fifty employs five or more hired hands during the year, and only one in six employs one or more. A similar description fits Canada, Australia, New Zealand, practically all of Western Europe, most of the Orient, and some of South and Central America. The usual farm manager is therefore also a farm laborer. As manager, he directs his own labor along with that of other members of his family, and of such hired labor as he may employ. He does his organizing and reorganizing, and his buying and selling, in his spare hours and days when labor needs are not pressing. Farms on which the operator and members of his family do much of the work are commonly called *family farms* in the United States, and by some equivalent term in other countries. The term will be used freely throughout this book.

Although most of the farms in the United States and elsewhere are family farms, they differ widely in character. A family farm in New Jersey may consist of 3 acres of land and 1,000 laying hens; one in eastern Oregon, of 3,200 acres of wheatland and a Diesel tractor outfit; one in Mississippi, of 2 mules on 60 acres of land growing nothing but cotton and mule feed; one in southeastern Wisconsin, of 100 acres of land used for corn, oats, and hay, and pasture for a herd of 30 dairy cows, heifers, and calves, and also to fatten a few loads of hogs in the course of the year; and one in Illinois, of 240 acres of land and an all-purpose tractor

outfit, with 80 acres in corn, 25 acres in oats, 20 acres in soybeans, and the rest in hay, pasture, and wood lot, and with 10 brood sows and 50 Shorthorn cattle. Some family farms are largely *self-sufficing* — that is, much of what is produced is consumed by the farm family. Others are *part-time* — that is, the head of the family has a job off the farm as the main source of his income.

Family farms differ even more by countries. The average family farm in Japan has 13 acres of land, of which 2.2 acres are in crops, and uses the labor of 4 persons, of whom only 0.6 of a worker is hired. The family farm of Czechoslovakia contains 20 acres of land, and uses the labor of 2.4 persons, of whom more are women than men, and 0.4 of a person is hired. The family farms of France average 29 acres and use the labor of 2.8 persons, of whom half are hired — farm families are small in France. The family farms of Scotland average 183 acres, of which 40 acres are in crops, and use the labor of 2.5 persons, of whom 1.0 is hired. The average farm in the United States contained 174 acres in 1940. Of these, 53 acres were in crops. This average farm employed 1.9 persons, of whom 0.5 of a person was hired. Farm management must concern itself with the managerial problems of all this wide range of types of family farms.

Although most of the farm managers of the world are operators of family farms, in many countries the major fraction of the farm land is in large holdings or estates. Even in the United States, 34 per cent of the farm land, if ranches are counted as farms, is in farms of 1,000 acres or over, and 14 per cent in farms of 10,000 acres or more. For California, the comparable figures are 66 per cent and 26 per cent. A majority of these farms, even in California, consist of semiarid grazing or dry-farming land; but still their volume of business is relatively large. There were 25,000 farms in the United States which in 1929 had a gross value of product of $20,000 or more. But large holdings are much more important in Russia, in the Spanish-American countries, and in parts of Europe and Africa, than in the United States. These large farms or estates present even more varied management problems than the family farms.[1]

We shall have a better appreciation of the magnitude and importance of the management function in agriculture if we simply list the questions

[1] Strangely enough, the usual full-time farm in England can scarcely be called a family farm. It employs five or more year-round hired hands. The usual operator does no manual work. Even the tenants do not labor in the fields. When the senior author asked several English farmers in 1929 what they thought of the family type of farm, such as prevalent in Denmark, the answer he invariably received was that a farm ought to be big enough so that a man could make a good living using his head instead of his hands.

that a farm manager must answer right if he is to succeed. These questions can best be considered under the heads of *organization*, *operation*, *buying and selling*, and *financing*. The term *Farm Management*, which is the title of this book, is commonly understood to include all four of these. Organization and operation can be distinguished by likening the first to the setting up of a machine and the second to operating it after it is set up. Operation, therefore, refers to the day-to-day planning and direction of the farm activities. Operation and organization may merge into each other when questions of reorganization arise. The questions first listed will apply especially to family farms operated by their owners. Later sections will list additional questions for larger farms and for rented farms. To help students answer exactly such questions as these, when they become farmers or farm advisors later, is the object of any textbook or course in farm management.

QUESTIONS OF ORGANIZATION

Not very often these days does a farm operator have the chance to create a wholly new farm business by buying the land for it, erecting suitable buildings, and buying the livestock and equipment to go with it. The nearest that he ordinarily comes to this is to buy a farm already in existence and then do his best to fit a farm organization to it. It is such a situation that is assumed here. Given a newly purchased farm to organize, the manager must find answers for the following types of questions:

1. *What to produce* — what crops and what livestock, or what combination of crops and livestock.

Of course, if the farm is in an area which produces only one farm product, and cannot economically produce anything else, the farmer answered this question when he bought the farm. Such farms are not as common in the United States as is supposed. But a few of them do exist, like the sugar-cane plantations of Louisiana; the citrus groves of California and Florida; the cranberry bogs of Massachusetts, New Jersey, and Wisconsin; the commercial poultry farms which buy all their feed; the dry-lot dairy farms of California, and the sheep ranches of the West. Most of the areas thought of as single-crop or single-product are not really such. The cash-crop cotton farms, for example, usually grow feed for their mules, and the operator has to decide how much and what kinds of feed to grow and what to buy, and what feed crops are best suited to his land. The northern cattle ranches grow the feed to winter

over their breeding herds. It is upon the diversified crop-and-livestock farm of the Midwest, however, that the question of what to produce becomes most involved. Here, crops and livestock must be fitted together into balanced enterprises.

Subquestions under the general head of what to produce are *what varieties of crops* to grow and *what breeds of livestock* to keep. Choosing between Holstein and Shorthorn and Hereford cattle is equivalent to choosing between dairy or beef, or dairy-and-beef production. Equally distinctive choices must be made among varieties of apples and oranges. Only less important are such choices as variety and staple or fiber length of cotton, cooking quality of potatoes, milling quality of wheat, and shipping quality of strawberries.

2. *What to grow on each field* — or what use to make of the different fields or kinds of land in the farm. This decision may involve the choice of the rotation system.

3. *What equipment to use* — what type of power and equipment to use in fitting the land and in planting, cultivating, and harvesting; what equipment for hauling produce and supplies to and from the market and around the farm.

A major decision in many parts of North America and the newer farming areas of the world is whether to use tractor power or horse or mule power. In Europe, the question more often arises in terms of horses versus oxen or cows. It may startle some Americans to learn that as many cows as horses are used as draft animals in Europe outside of Russia. In the United States, an important decision still in many grain-growing areas is whether to use a tractor combine or self-binder. In parts of Europe, one may find in use within a day's travel the sickle that one reads about in the Bible, the cradle that our forefathers used on this continent, the hand-rake reaper, the self-rake reaper, and the self-binder. And in another day's travel, he may find a tractor combine in use. Farm machinery has been evolving rapidly in the last one hundred years. Besides the tractor and tractor combine, other recent innovations in the United States are the corn picker, the field hay baler, the cane harvester, and silo-filling equipment. This generation may see the wide adoption of the cotton picker. At what point in time it is advantageous to introduce a new type of equipment on a particular farm is rarely an easy decision. Many thousands of farmers have purchased trucks, tractors, or tractor combines before their farms could use them economically.

4. *What farm practices to employ* — The farms in any region may exhibit a wide variety of practices in preparation of the seedbed, in the care of crops, and in the feeding and breeding of livestock. Suffice here merely to list a few of these to serve as illustration — plowing versus disking; terracing versus strip-cropping, versus contour cultivation, versus keeping the land all in grass or in close-grown crops; liming the soil; winter cover crops; summer fallowing; pasture management; and the time of freshening of dairy cows, or of lambing or farrowing. Differences in the land from field to field on the same farm may call for differences in practices.

5. *How much to use* — that is, at what *rate* to feed and at what *rate* to apply fertilizer; *how much* man and horse or tractor labor to apply in tilling the land and hoeing or cultivating a crop; *how often* to spray. Upon the rate of feeding will largely depend the rate of gain in weight of a growing or fattening animal, the output of milk per day or during a lactation period, the number of eggs laid by a hen in a year. Similarly, upon the frequency of cultivation of a row crop will depend in part its yield per acre. The farm manager must decide what rate of application of all these production factors is most advantageous.

6. *What fertilizer formula or feed ration to use* — The yield of crops depends not only upon the amount of fertilizer applied but upon how the nitrogen, phosphate and potash in it are balanced. The fertilizer formula needs to be fitted to the particular crop and related to the elements already in the soil. In a similar way, dairy and other feed rations need to be balanced to suit the animal and the type of output which is desired, whether it is milk or meat or eggs.

7. *What particular individual producing unit to use* — The different animals in a herd of livestock present a wide range in productivity. Some cows are able to produce three times as much milk as others; some meat animals, to grow and take on fat more rapidly than others. Few abilities are more important in a competent farm manager than the ability to select high-producing animals. Yet it is always possible for a poor manager to spend more money on high-quality livestock than he is able to get back in increased output.

If choosing livestock is important, so also must be selecting farm laborers and the proper makes and types of equipment. The power machines now coming into use call for a high order of mechanical skill

and judgment. Carelessness in their use may wreck the machines and cause serious injuries to workers.

QUESTIONS OF OPERATION

Having found the right answer to all the questions that come under the foregoing seven heads, the farm operator will have determined the basic organization of his enterprise. But he will still have a constant succession of decisions to make from day to day and week to week — decisions of *operation* as distinguished from organization. Let us suppose that the time is approaching for the hay harvest. The farmer watches his hay closely to see when it is at the right stage of maturity, but he also watches the weather. At the most propitious hour he takes his mower into the field and cuts as much as he thinks will cure and can be stacked or hauled into the barn before the next rain. But if the hay is all to be harvested before it is too ripe, an additional lot needs to be curing while the first is being stacked. The grain harvest presents the same day-to-day succession of problems and decisions. The growing crop of corn, cotton, tobacco, or potatoes must be watched with equal care so that it is cultivated and sprayed at the right times. Livestock is not always exposed to the same uncertainties of the weather, but is exposed to other hazards just as serious. Breeding and feeding operations need to be followed in equal detail.

An important part of operation is the planning of the work. Some farmers manage to get all of their work done on time and to get it well done, and others are always behind and constantly having to slight some job because of pressure of time. A frequent topic for conversation whenever the farmers of a certain community came together, at the creamery in the morning, or at threshing time, was the troubles the Ralph's were always having. Every member of the family worked hard, but still the work never seemed to get done. Sometimes the farm immediately across the road was contrasted with it. The preacher, who had lived in the community for twenty years, finally summed up the situation aptly by saying that at the Stevens farm they always "planned ahead and did next the thing which was most important to be done next," but at the Ralph farm "the work was never planned a week or even a day or two in advance, and when they got up in the morning they went out and did the first thing that came to hand." Good farm management requires that the farm operations be planned several weeks in advance, and that the equipment and supplies be made ready for use when they will be needed; and that this plan be revised from

week to week and day to day as conditions change. Sunday on many farms is the time when the work is laid out for the coming week. Each morning the work must be laid out for the day.

Organization and operation are interacting and overlapping. For instance, the farmer may have planned to put corn in a particular field. Because of a late season, the land cannot be plowed in time for corn, and so soybeans are planted. Early or late frosts, drouths, insect ravages, unpredictable storms, may call for sudden changes in the farm program.

On farms employing hired labor, maintaining cooperative friendly working relations with employees is an important phase of operation. Many farmers with the knowledge and managerial skill to run sizable enterprises are forced to confine their operations to what they can handle themselves because hired labor will not work for them. On large-scale farms, labor relations take on the same character as in factories and in many respects are more difficult.

QUESTIONS OF BUYING AND SELLING

A farmer can be a very good manager as far as organizing his business is concerned, following good practices, and keeping the work well planned from week to week, and yet not make a very good showing in his balance sheet because he does not buy and sell well. He pays too much for what he buys and sells at too low prices. It is commonly said of such a farmer that he is not a good businessman. A more accurate statement would be that he does not handle well the more commercial aspects of his business, since good organization and management are necessary parts of a good business as well as buying and selling.

There are a number of ways in which a manager may fail in his buying and selling. One is that he does not plan his production in such a way as to have a product to sell when prices are good. The farmer who has much to sell when prices are low, and relatively little when prices are high, cannot possibly make a good showing in his balance sheet. Yet farmers tend to plan their production from year to year in exactly this way. It is equally important to bring produce to the market at the time of the year when it sells at the highest margin over costs; and this is by no means always when prices are highest.

An equally common type of weakness in the commercial end of farming is not using good judgment as to prices paid for supplies and equipment and livestock. One reason for this may be that many farmers do not follow the markets closely; another, that they may not be good bargainers. They may also use poor judgment in hiring labor.

So many family farmers are relatively incompetent in their buying and selling that this has become an important reason for the development of cooperative marketing in agriculture. The cooperative employs a man who specializes in this function. The individual farmer knows that he will get the same price for his product as his neighbors if he sells through the cooperative. The cooperative will also be in a position to select feeds, fertilizers, and other supplies more understandingly than he can do it himself. Large-scale farms are more able to provide these specialized buying and selling services for themselves.

The most serious mistake that a farmer can make in buying and selling comes at the time when he buys a farm. Several hundred thousand farmers in the United States lost their farms at forced sale between 1921 and 1936 because of buying farms at too high prices in 1918 to 1920. One can also make a mistake by buying a farm in an area where the agriculture is declining. For a period of over twenty years just before 1900, the prices of farms declined in large sections of the northeastern United States. Most of the farms were bought in this region in these years at too high prices. Also, in a given community some farms are sold for more than they are worth and others for less. The land market is poorly organized. There are no acknowledged grades of land such as for wheat and cotton. The buyer himself must judge the quality of the land and buildings. Farms that have been well managed often sell for more than they are worth, and poorly managed farms for less, because the farm gets the credit for the management.

QUESTIONS OF FINANCING

The ordinary family farm does not require a large capital investment. But its financing is fully as difficult in proportion to its size, and the consequences of mistakes are no less serious. A large corporation employs a specialist to handle its financial problems. One can scarcely expect the ordinary family farmer to be a specialist in financing. Most farmers are in debt. Relatively few of them have resources enough of their own to finance a farm business. They borrow to buy their farms in the first place, to repair or enlarge their buildings, to buy needed equipment and livestock, to meet the expenses of growing their crop through the harvest, to buy feeder cattle or hogs, and for a long list of related purposes. Some farmers borrow too often and too much; and others err in the other direction, being too timid to borrow what they need in order to earn a good income. An enterprising farmer is faced recurrently with decisions as to whether or not to borrow to increase the productivity

and earnings of his farm. He may see an opportunity to save money by buying laborsaving equipment, to buy a few more cows and some concentrate as a way of using his farm-grown forage and feed more effectively, to enlarge his poultry enterprise as a way of using his management or labor more fully, to tile-drain one of his meadows and convert it into tillable land, to buy a sire with a better production record. All such opportunities need to be analyzed, and weighed against each other as to the investment involved, how soon they will yield an increase in income and how much, and the risks and uncertainties involved.

Moreover, all times are not equally good for borrowing. Altogether too many farmers become venturesome just before a depression. Similarly, there are times when it is wiser to increase the earning power of the farm by productive investments than it is to reduce the debt further. It should be apparent that there is much more to good farm financing than paying off debts when prices are high and using more credit when prices are lower.

INTEGRATION

The questions listed under the four heads above cannot be considered separately from each other. Organization, operation, buying and selling, and financing cannot be combined as a mixture in which each ingredient retains its own characteristics. They must be fused. It is this compounding which gives cohesion to the farm business. How crops must be fitted together in sequence to use the soil effectively is familiar to the beginning student of agronomy; and how feed and forage crops and livestock need to be balanced is considered in courses in livestock husbandry. But fitting all of these together into one business unit in such a way as to use land, labor, and other resources most effectively is a task in integration that is more than a sum of the parts. Similarly, the planning of the cropping program and its financing must be done at the same time. All too often farmers are niggardly about borrowing funds to the detriment of production operations and the returns from a season's efforts. Perhaps $50 is borrowed in the spring, and because of poor planning, another $75 has to be borrowed later. Or a whole summer's work may be endangered by skimping and failing to hire a large enough crew at harvest time. With a crop like peanuts, delays in getting them out of the ground may result in large reductions in yields. Lagging in cotton picking until a heavy rain comes at the time when most of the bolls are open may greatly reduce the quality and sales value of the crop. Thus, the production and financing operations must

be integrated if net returns are to be maintained at high levels; and similarly the production and the sales.

The opportunities for better integration have been increased by the growing use of power units which introduce more flexibility. Clearly the all-purpose tractor provides such flexibility; also electric motors and the electric fences and other livestock equipment which are readily movable. Even such aids as removable panels made from lightweight materials make it much easier to convert farm building floor space to a wide range of uses.

A diversified farm business is a highly complex organization. The writer once visited a plant where a special high-quality type of iron was being smelted by using charcoal instead of coal. The fumes from the kilns in which the charcoal was made were converted into several by-products. These processes required sulphuric acid, which was made from sulphur driven off some of the ore in large roasters. The fumes from the kilns were also used to preheat the air forced into the blast furnaces. Anyone would say that this was a highly integrated and complex organization. But as a matter of fact, any diversified-crop-and-livestock farm, such as analyzed in Chapters XIII and XIV, probably has twice as many interrelationships between lines of production as this smeltery.

LARGE FARMS

Most tasks of management are the same for a large farm as for a small one except that they occur on a larger scale. Hiring one hundred laborers is the same kind of task as hiring one, and marketing a thousand bales of cotton is the same kind of task as marketing five. But on the larger enterprises, a particular function can be organized more carefully, and frequently a specialist can be employed for it. The hiring of one hundred laborers can be done much more systematically than the hiring of five.

A task that is more or less special to large farms is supervising the work of laborers spread over a large area. Also, as already indicated, management-labor relations take on new form with a large squad of workmen. And a large farm is more likely to employ large-scale equipment, which introduces the problem of keeping it in good working condition.

RENTED FARMS

Regardless of the particular form of lease, the management of a rented farm is always divided in one way or another between the land-

lord and the tenant operator. The division at one extreme, as upon many cotton plantations in the South, is so far over to one side that the landlord not only determines the organization of the farm business and does all the buying and selling and financing, but he virtually directs the tenant — called a *cropper* under these circumstances — as to what to plant in each field, when to plant his cotton and when to cultivate and to harvest it. Landlord management may be carried to the point even of directing the work of the cropper each day. At the other extreme, on a farm rented for cash in England, the landlord does practically nothing except to receive his rent and occasionally give his consent to having some new buildings or other improvements put on his farm, or possibly to having some timber cut. On the usual share-rented farm in the United States, the tenant follows a crop-and-livestock system which has been agreed to jointly by the tenant and the landlord, and the buying and selling is done more or less jointly. The day-to-day management of the farm is handled by the tenant. Under cash leases, the landlord reserves control principally over the use of the land and buildings.

The division of the managerial functions between the landlord and the tenant raises many difficult problems of landlord-tenant relationships, but the basic managerial decisions are of the same general nature. The terms of the lease need to be such that the system of management which is best for the farm in the long run is also best for the tenant. Most leasing arrangements do not measure up to this requirement.

FARM MANAGEMENT AS A SCIENCE

Teachers of farm management are accustomed to refer to their subject as a science. This is a correct statement if one understands the term science to include *applied* science as well as *pure* or *fundamental* science. Farm management is the same kind of a science as engineering, medicine, or agronomy. The logical distinction between the pure and applied sciences is generally understood. Meteorology, the science of weather, is a pure science. Forecasting the weather is an applied science.

One also hears farming and farm management described as *arts*. They do have some of the attributes of an art. Primitive agriculture was all art. It continued to be so until science had built a foundation for agricultural practice. The early books on agriculture consisted of nothing but a set of rules as to how the lands should be tilled, and when and how the crops should be planted, and the like. These rules had little scientific basis. A surprising number of them have since been proved

to be scientifically correct, but the reasons for them were not understood at the time. Even the early scientific explanations were commonly wrong. Not very much that was really scientific was known about breeding before the time of Mendel. Early medicine was also an art, and not much that was really scientific about it was understood before the time of Pasteur and his contemporaries. Jethro Tull's *Horse-Hoeing Husbandry* was science, but not very good science, resembling in this respect a recent book on the same general subject, Faulkner's *Plowman's Folly*. The German soil scientist Liebig did more to put plant growing on a scientific basis than any of his predecessors. Even today, however, many things in agriculture are done as they are because we learned to do them that way from our predecessors and they seem to obtain results.

Although it is generally agreed that farm management is now more largely an applied science than an art, there is no common understanding as to the sense in which it is an applied science. That farm management consists of the application of scientific laws and principles to the conduct of farm activities is easily enough understood. But applied science has another phase. This was brought out by Alfred Marshall in his *Principles of Economics* when he spoke of pure science as dealing with broad general principles, whereas applied science deals with "narrower questions more in detail."[2] To illustrate, the general science of economics includes a principle concerning the proportions in which the factors of production are combined to best advantage — commonly called the Law of Diminishing Returns. Farm management, however, must deal with the rate of application of particular factors of production under highly particular circumstances; for example, the rate of applying fertilizer to a cotton crop in a particular cropping system. The Principle of Comparative Advantage of general economics states that a particular product tends to be produced in the area or location where the factors used in its production give the largest return as compared with other products in the same area and in other competing areas. But farm management must determine what crops to use in combination with corn in a cropping system in a certain area. Not until these principles are narrowed down and refined so that they fit a particular situation are they useful. Applied science must do this kind of narrowing down or refining of principles. *It therefore has principles of its own.*

It is highly important, however, that these principles be not inconsistent with those offered by the basic sciences. If a conflict appears to develop, either a restatement of the general principle is required or something is wrong with the statement of the narrower applied science

[2] 6th edition, p. 37.

principle. More often the second is true than the first. An example of this from the field of general economics was H. L. Moore's conclusion from his studies of prices of steel and other industrial products that the demand curve for them slopes upward to the right — meaning that more is bought at high prices than at low prices — and that this calls for a restatement of the law of supply and demand. Other economists had to point out to him that his analysis contained not one demand curve but a succession of them at different stages of the business cycle.[3] All of these slope downward to the right, but much more steel is bought at peaks of the business cycle than during depressions. We shall later find examples of farm management principles that have called for restatement of principles of economics and of other basic sciences. But much more often the reconciliation has been in the opposite direction.

The other important characteristic of applied sciences is that ordinarily they draw their basic principles from more than one source. Engineering makes use of the principles of mathematics, physics, and chemistry, and often others besides. Medicine draws heavily from the broad field of biology as well as from chemistry and psychology. Farm management draws upon two groups of sciences: on the one hand, from the natural sciences of chemistry, physics, and biology, and the more specialized sciences of nutrition, genetics, soil science, and the applied sciences of agronomy, animal husbandry, and the like, based on these; and on the other hand, from the social sciences of economics, sociology, anthropology, and political science. It also draws heavily upon psychology, which in some of its aspects is natural science and in others is social science. It draws upon the sciences usually not one at a time but in various combinations. The situations that arise in agriculture, as in the other applied science fields, do not conveniently address themselves to the farm manager as problems in soils or agronomy or plant pathology or economics. Whether or not to grow soybeans in an area involves not only the plant sciences and soil science, but also the economics of the use of labor and equipment and of prices and markets. The introduction of the cotton picker will have profound social effects that will call for economic and other social analyses of great complexity.

The farm manager must bring all these sciences to bear on his problem, and in their proper relation to each other. Somehow or other he must coordinate the application of this diverse group of sciences. Coordination of the sciences is performed on several levels. Soil science coordinates chemistry, geology, physics, and biology. So also does nutrition. Agron-

[3] Elmer J. Working, "What Do Statistical Demand Curves Show?" *Quarterly Journal of Economics*, February, 1927.

omy, animal husbandry, and dairy husbandry bring in still other natural sciences. Economics, and its subordinate subject, farm management, must integrate economic considerations of price and value with all the foregoing. In the final analysis, the coordination of farm management always involves economic factors of price and cost. Hence, economic science plays an important part in all farm management decisions. Some of the other basic sciences may not be much involved in particular decisions, but economics always enters in. It is for this reason that courses in farm management are commonly offered in departments of economics.

FARM MANAGEMENT LOOKS AHEAD

The final point to be made in this introductory chapter is that the farm manager is always planning for the future. It may be only how to use his labor in the next day or two, it is true; but even then he is looking forward to the tasks that must be completed in the next few weeks. The larger managerial decisions mostly involve a time-span of a crop season or a year, and some of them may involve investments in equipment and buildings that last half a lifetime.

The experience of the past can be a very useful guide to the future in farm management as in all things. But every fact or figure taken from the past must be adapted to fit the circumstances that seem most likely to prevail over the time-span for which the plans are being made. This exchange took place at the annual meeting of the American Farm Economics Association in 1922. Member B had spoken of the necessity of forecasting, essentially, the prices that would prevail when the crop was sold, and also the wages that would be paid for labor, and the prices for feed and fertilizer, before a decision could be made as to what to produce in the coming year. Member M protested. He said that no one could forecast prices of wages and that farmers should base their plans on the average prices and costs that had prevailed in the past few years. Member B's answer was: "I hope you realize that when a farmer does this, he is simply forecasting that prices and costs are going to be the same next year as in the past; and surely a majority of farmers, at least with some help from extension workers, can do a better job of forecasting than that."

Not only must prices and costs be anticipated, but also changes in technology, new varieties and breeds, new types of machines, new methods of disease control, and new methods of soil management.

The successful farm manager must therefore be constantly on his toes ready for the next move. He is not operating in a static world, but

rather in a world in motion. He must keep in the current of change or the world will go off and leave him. If each growing season were exactly like every other season, if prices always remained the same, and if no other factors changed from year to year, *the management problem would largely disappear*. By a process of trial and error, perfect production methods would be discovered and adopted in such a changeless world. One way of organizing a farm would always be the right one. One cropping system would always be best, one rate of feeding cattle, one fertilizer formula, and one system of tillage. It might take some time for all farmers to learn by experience or imitation what the one best way for everything was; but once it had been learned, a young man growing up on a farm would learn these ways and never have to change them. They would become the habits of one generation and the customs of all succeeding generations. There would be no farm management problem whatever. Clearly, therefore, farm management as a field of study and research and as an art owes its existence to the dynamic factors in civilization. The essence of farm management is therefore dynamics. This aspect of farm management will be developed more fully in Chapter VI on "Farming in a Changing World."

FURTHER READING

* Neil W. Johnson, *Planning the Farm for Profit and Stability*, U.S.D.A., Farmers' Bull. 1965, 1945.

Social Science Research Council Bull. 13, *Scope and Method of Research in Farm Management*, pp. 4–16.

EXERCISES

1. Make a list, under the four heads, organization, management, buying and selling, and financing, of the more important questions that must be answered by the operator of the farm in your home community that you know best.
2. List under the two heads, technological and economic, the most important changes that have affected the agriculture of your community in the last ten years.
3. What do you consider the most common shortcomings in the management of farms in your community?
4. List the courses which you have taken, are now taking, or will take, which you expect to be directly related to farm management, and indicate how they are related to it.

CHAPTER II

The Organization of Agriculture

AGRICULTURE CONSISTS OF MUCH MORE THAN SO MANY FARMS OF THE kinds described in the last chapter. The farms can be fitted together according to many different patterns. It is the purpose of this chapter to discuss the patterns of interfarm agricultural organization. Some attention will need also to be given to the organization for the buying, selling, and financing operations as well as for the producing.

SCATTERED FARMS

The major distinction in pattern of interfarm organization is that between having the farm homes and farmsteads scattered all over the countryside, and having the farmsteads packed closely together in a village, with the farm lands located out from the village, which means that the workers must drive or walk out to the fields every day, haul in feed from the fields for their livestock in the village, and haul manure back to the fields. The only clearly marked farm-village organizations in the United States are in Utah and southeastern Idaho, but in the world at large more farm families live in villages than on scattered farms. Let us first consider the different types of scattered-farm organization.

THE RECTANGULAR PATTERN Except in the Northeast and in the South, most of the land in the United States is laid out in a rectangular pattern like the blocks in cities in the same territory. This rectangular survey was made standard in this country in 1784–1787 when the Northwest Ordinance was being evolved. It had been used enough in the colonial period to attain the favor of those who were laying the foundation for a great empire to the west. All the land surveyed since, beginning at a point in eastern Ohio, has been fitted into this general pattern. The unit of farming land is a *section* of 640 acres one mile square. Thirty-six of these sections, numbered 1 to 36, beginning in the upper right-hand corner, make up the standard *township*. The townships are numbered 1, 2, 3, and so forth, north and south of the lines of latitude called

Principal Base Lines, as in Chart 1, and according to range numbers east and west of the Principal Meridian Lines. Thus, it is very simple to describe James MacGowan's farm as the northeast one fourth of Section 14 in Township 6 North, Range 5 East, designated as X in Chart 1.

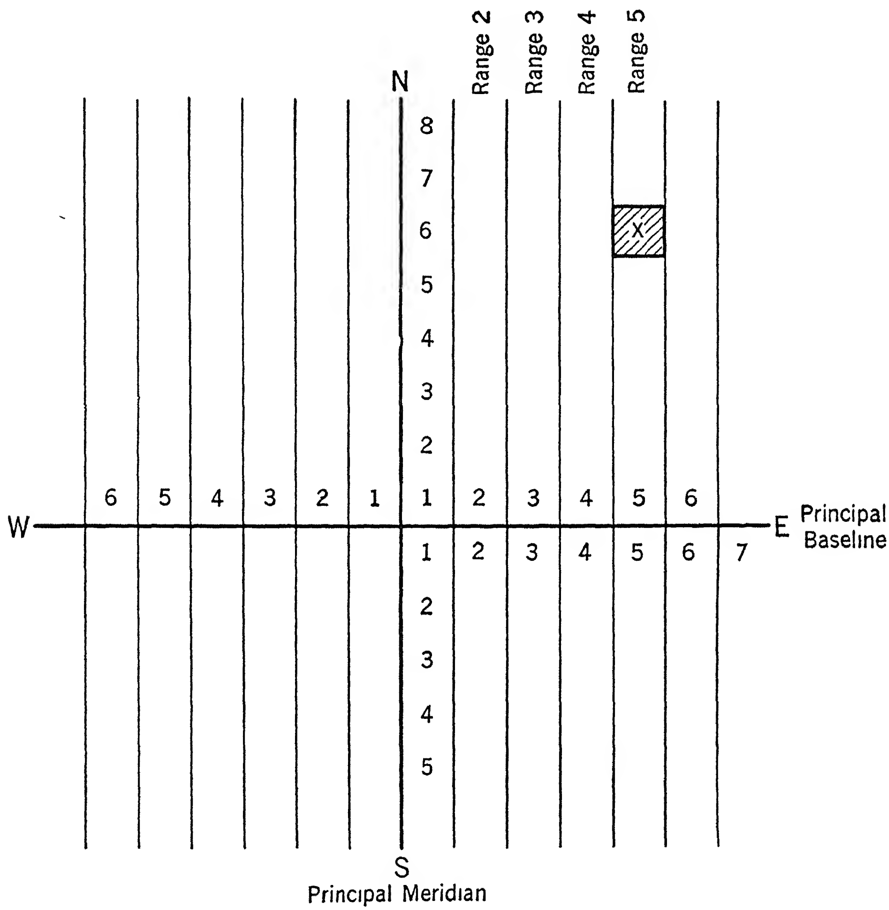

CHART 1. The township survey system of the United States.

The First Principal Meridian separated Ohio and Indiana, starting from a Principal Base Line on the Ohio River; the Fourth started from the mouth of the Illinois River and controlled the surveys northward in Wisconsin and Minnesota. The Montana Meridian, laid out in due time, runs north and south from a limestone hill, Longitude 111°, 40′, 54″ West of Greenwich. The Principal Base Line was laid out east and west of this hill. These two lines governed the survey for all of the

Montana territory.[1] Thus the whole West and Midwest was covered with a network of Principal Meridian and Base Lines.

In level country the roads commonly follow these section lines. This is very economical of distance if one happens to travel to some point directly east or west or north or south on the same section line, but wasteful of distance if one goes anywhere else, for one must always travel on two sides of a right-angled triangle. To get to Shortville from Neilsville, one must travel six miles north and then three miles east. He can go catercorner along the section lines, but he will save no distance. However, in rougher terrain the roads are likely to follow the landscape. They follow the streams, bend around steep hills, and keep to ridges and valleys, with only occasional steep interconnecting roads. Even though the land was all laid out in sections when the settlers came, Indian trails frequently preceded them. Or perhaps gaps in mountains or fords in the rivers determined the points where the early settlements grew up, and the interconnecting roads followed the easiest natural course between them.

IRREGULAR PATTERNS The land taken into farms before 1787 had for the most part followed no regular pattern. In the South, the holdings were more or less irregular pieces of land laid out along trails and rivers. The first settlers selected tracts of land according to their preferences and set up boundary lines around them. Those who came later had to fit in among the first holdings as best they could. The roads were extended to serve the holdings as they were acquired. In the Northeast, the laying out of farms and roads often followed a more conscious effort. Tracts of land were granted to groups of families who split off from the rest and formed corporate communities called "towns."[2] At some point in the town favored by nature, a village was laid out, frequently with a little common land in the center. The settlers located their farmsteads along the roads leading away from the village, which were usually made to follow the valleys or ridges.

Thus, the town of Petersham in Worcester County, Massachusetts, was granted to seventy-two veterans of the Indian wars who were called the "proprietors." They laid out seventy-two "house lots" of 55 to 100 acres along a ridge running north and south in the center of the town. The rest of the town was divided among the original proprietors and their heirs in five subsequent divisions. The additions at the start

[1] Donaldson, *Public Domain*, p. 181.

[2] The term "town" instead of "township" is used in the Northeast. Roughly equivalent terms in other sections of the country are "precinct," "militia district," "civil district," and "beat."

were mostly in adjoining tracts; later, they were in separate tracts. The final division, consisting of woodland and swamp that had been held as common land up to that time, was made in 1770. This type of settlement was most characteristic of New England, as the other was of the Old South.

DIVIDED HOLDINGS Getting a good balance of arable land, woodland, and meadow is not easy with any pattern of land holdings. With the rectangular survey, the lines run north and south without any regard to types of land. In spite of much buying and selling over the years, many farms do not have a good balance of types of land. This difficulty is frequently overcome by making up a farm out of tracts in two or more locations. Farmers in an area all made up of highland may own small pieces of marshland in the bends of rivers or at the swampy ends of lakes. In years of drouth, the farmers in adjoining areas went onto these marshes to cut wild hay; or in the wintertime, to cut bedding. Later they bought it, sometimes directly from the government, in tracts of 10, 20, or 40 acres. Tracts of rough timberland have similarly been divided among farmers in surrounding areas having only arable land. Along the Atlantic seacoast, near-by farmers have parceled out in a similar way the tidal marshes which grow a type of grass which is esteemed highly because of its iodine content.

Such division of holdings is much more developed in Europe than in the United States, partly for historical reasons, as we shall see later, but more because the pressure of the people on the land has made them use it more wisely. It will develop further in the New World over the centuries.

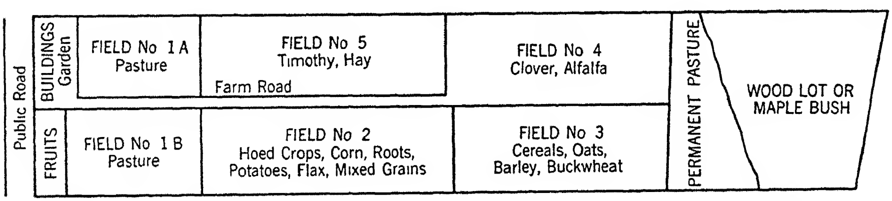

CHART 2. Layout of a typical farm in Quebec — 120 acres. (Supplied by the Department of Agriculture of the Province of Quebec.)

PARALLEL STRIPS The early French settlers in America seem everywhere to have laid out their holdings in long narrow strips reaching back from rivers or roads. Figure 1 shows how this pattern has been developed along the St. Lawrence River in Canada. Chart 2 shows the layout of a typical farm. Originally, the strips were laid out along the rivers so as to take advantage of river transportation. Later as roads

became more convenient forms of transportation, they were laid out along the highways. The effect of this is to bring farmsteads very close together so that the family life takes on almost a community pattern. Especially did this come to be the case when the farms were subdivided subsequently to provide land for married sons and daughters. Part of the farms are laid out in this way along the Fox River near DePere, Wisconsin, and along the Chippewa River near Durand in the same state.

A layout somewhat similar to this occurs in Holland as a result of a method of reclaiming the land. The first step in bringing land out from under the sea is to build a high dike. After the water is pumped out behind it and the land is in condition to cultivate, roads are located on the tops of the dikes and many of the farmsteads along the sloping banks.

GRAZING AREAS The semiarid grazing areas of the United States developed a scattered-farm type of organization. The farmsteads are frequently located away from the highway in some spot which has natural advantages of water and of protection from the winds. Or they may be located along streams and at the base of mountains where winter feed can be grown. In the last two decades, a new pattern has appeared in a few areas. The grazing lands have been thrown together and operated cooperatively, each farmer being allowed to graze a certain number of animal units according to the amount of grazing land which he contributed to the cooperative range. The farmsteads can be moved to better locations where some cropland is available and perhaps small amounts of irrigation water.

VILLAGE ORGANIZATION

The village type of organization was characteristic of the early forms of settled agriculture and also of the feudal system which succeeded it nearly everywhere. It disappeared almost entirely in England with the Second Enclosure Movement, which was at its peak in 1760–1815.[3] A remnant of the village type of agricultural organization may still be seen at the Isle of Axholme, north of Cambridge. Here still are to be found alternating strips of land in barley, clover, wheat, and root crops stretching back from the roads on either side.

The arable fields, under this system, were owned in common. A family had a right to farm one or more strips in each of the fields. The strips

[3] "Enclosure" is the term applied to dividing large open arable fields, pastures, or meadows into consolidated individual farm holdings and building fences around them.

were separated by narrow grass-covered ridges called balks. Any one field would all be in one crop. The woods, pastures, and meadows were held as *common* lands, not laid out in strips. Each family had a right to pasture a certain number of cows or sheep on the commons, and to cut a certain amount of hay or timber. As the population of the villages grew, each family's share might or might not be reduced, depending upon the custom of the country. In the Russian villages, called "mirs," the land was redivided at intervals. The average amount of land per family in the Russian mirs declined by as much as a third in the century preceding the Revolution in 1917. But in most sections of Europe the families still live in their villages and drive or ride or walk out to their fields. Driving west from Berlin toward Holland, one comes upon a rural village every 4 or 5 miles, and every 15 to 25 miles upon an industrial city or larger trading center.

The layout of the arable land surrounding the present-day villages of much of Europe is still largely in strips. These are often laid out on contour lines, like the strips used in this country to check erosion except that they are narrower. The balks between the fields no doubt serve somewhat the same purpose as the bench terraces used on hillsides in the Piedmont area of the South. But they really are property lines and have been in the same place for centuries. In France, the holdings of the individual families have been split so much in passing from one generation to another that a farm commonly consists of strips or patches of land in several different places. In Germany, the more usual practice is for one of the sons to take over the farm and pay off his brothers and sisters.

The perpetuation of the village organization is more easily understood if one bears in mind that the average size of a holding in most of this territory runs from 20 to 30 acres. Large numbers of them are from 5 to 10 acres. This makes it possible for a hundred families to live in one rural village and work on the adjoining land.

Many of the medieval villages were located on relatively inaccessible sites because of the need for defense against marauding tribes. In Italy, one still sees these villages located away from the roads on the high points in the landscape. They have been slowly moving down into the valleys in the last century or two, by a process of gradual growth of new villages on the highways and decline of the older villages.[4]

The usual type of village layout has a main street running through

[4] Similarly, the early villages in New England tended to be located on the high peneplains. When water power came into use for sawmills, gristmills, and particularly textile mills, the new villages which sprang up around them supplanted the earlier ones.

the village, on which the stores and the farmhouses front. If the village is a bit larger, there will be side streets and cross streets, always with the houses fronting on the streets. In Bavaria in southern Germany, however, the main street runs between the barnyards and manure pits, and the farm dwellings are fronted by narrow patches of lawn and adjoining gardens.

Though the village organization has been abandoned in the Scandinavian countries and in the British Isles, the village way of living has not wholly disappeared. Thousands of small hamlets still include the homesteads of abutting farms, and usually a number of part-time or very small holdings. The cottages of the married farm laborers working on the farms adjoining the village make up a good part of some villages.

The United States has many thousands of hamlets of this same type. In the one in which the senior author taught school about the turn of the century in Jefferson County, Wisconsin, the population of around a hundred included the families of five family farms, four farmers living on a few acres who had other sources of income, and the families of several retired farmers, in addition to the families of the two storekeepers, the postmaster, the buttermaker, the preacher, the blacksmith, and the graveyard keeper.

UTAH FARMING VILLAGES [5] The villages in the United States most like those of Europe owe their existence to the ideas of the early Mormon leaders, who in setting up their first village were trying to lay out a model "City of Zion." The pattern was followed in most of the other early agricultural settlements in Utah. It has persisted in large part for other than religious reasons. It fitted well into the agricultural conditions of that area, and adapted itself to its environment as it developed, and to changes in its environment. Today modern transportation is affecting it most.

A major factor in the early organization was dependence on irrigation water. The first settlers constructed canals leading water from the streams out onto the dry land and laid out the irrigated land in small fields surrounding the village. Chart 3 shows a possible cross section of one side of such an irrigated valley, with the canal following a contour at the foot of the sloping lands rising to the mountains behind. Toward the center of the valley, below the present-day highway, lie wet pasture lands. At first, these were used as a grazing commons, but in time came to be privately owned and individually used. After the early irrigation developments were well under way, the settlers gradually acquired

[5] W. Preston Thomas of the Utah Agricultural College and Lowry Nelson of the University of Minnesota supplied information for this section.

substantial herds of cattle and sheep. The native plants in the mountains furnished feed for these animals in summer. At a still later date, it was discovered that some of the dry lands could by summer fallowing be made to grow wheat. Four distinct types of land have thus become available — mountain and foothill grazing land, foothill grain land, upper valley-floor cropland, and lower valley-floor pasture land.

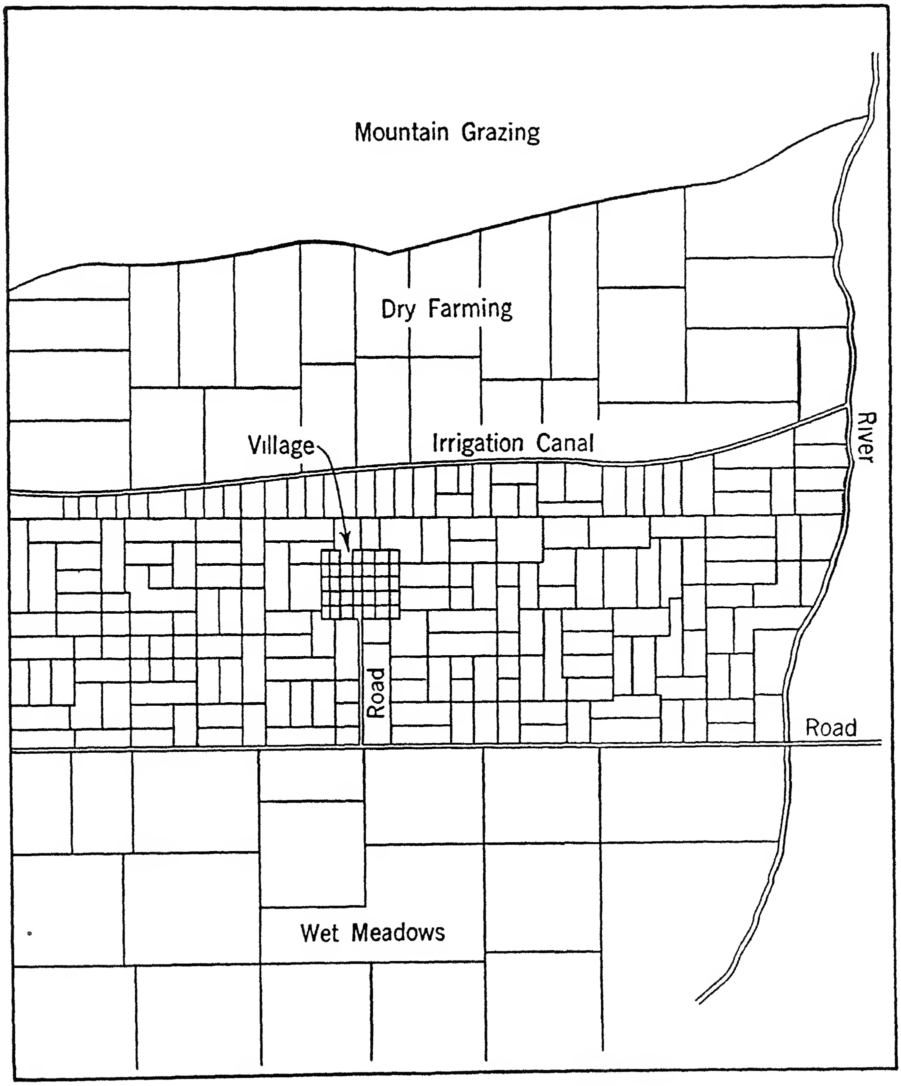

CHART 3. A cross section of one side of an irrigated valley in Utah, with a village in the center. These villages are from four to eight miles apart. (A composite, not an actual cross section.)

Originally, the settlers usually held all their land, except the home lot in the village, in one piece. But when a holding was inherited by several sons and daughters, it was often divided equally among the heirs. A young farmer and his wife might each inherit a separate piece of land in this way, and perhaps buy a small piece in still another location. Within a few generations, the usual farm consisted of several fields in separated locations. The typical farm in most parts of Utah is therefore a town lot plus several parcels of land of assorted sizes and types, located in several directions and at various distances from the town lot on which the dwelling, barn, and other farm buildings are located. Living thus in a centrally located village, the present-day farmer may have a combination of two, three, or four land types. The farming thus tends to be highly diversified. The farms average around 40 acres of good irrigated cropland. It is obvious from the chart that there is additional wet pasture land, dry-farming land, or mountain-grazing land for only part of them.

Each village is laid out into blocks, eight blocks to the mile. The block is about 600 feet square, and the individual lots 300 feet deep and of varying width — about 75 feet near the village center, but twice that elsewhere. Around the edge of the town, the house lots may include small pastures. The lots are laid out so that the houses so far as possible face each other across the streets, as in Chart 4. A garden is an important part of each farmstead. Irrigation water for garden use is distributed through the village in small open ditches. On the smaller farmsteads, a dry lot serves as an exercise ground for the cows and other livestock. The few business establishments are in the center of town around the village "square" or central block, which is occupied by the church, school, and other public buildings and otherwise used for a park. The typical village contains about 700 people, or 120 families, all farm families except for the schoolteachers, the businessmen, and the retired farmers.

This pattern of rural settlement has both advantages and disadvantages. The children can walk to schools large enough to be efficient, and everybody can walk to church on Sunday. Most of these villages now have electricity and town water systems, and some have sewage systems as well. All these services can be provided more cheaply in villages than would be possible for scattered farmsteads. On the other hand, much time is spent in going to and from the fields and in hauling crops in and manure out. Though close proximity to neighbors has advantages, it often leads to friction and even strife. A survey of eight Utah villages in 1941 revealed a tendency for new homes to be built outside of the

village. Hence, it may be that in time these villages will gradually lose their compact and highly integrated character.

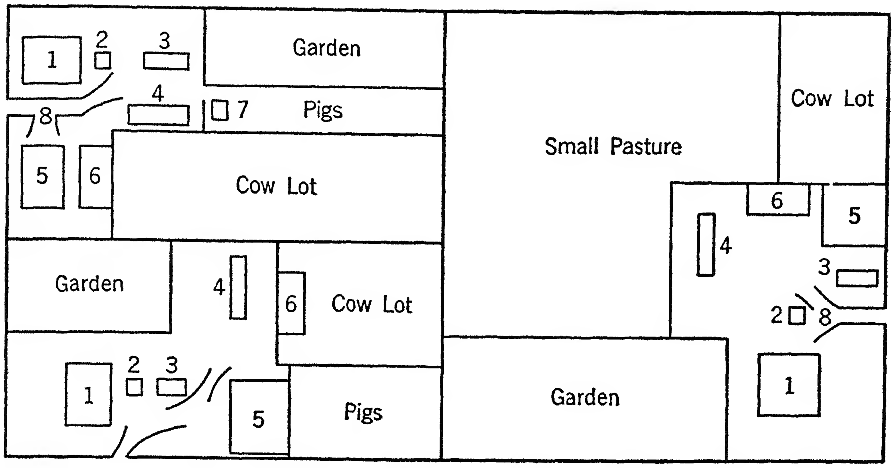

CHART 4. Types of layouts of house lots and farmsteads in a Utah farming village. Two of these are 300 × 150 ft. and the other is 300 ft. square. Near the village square the house lots are only 75 ft. wide.

1. Dwelling
2. Garage
3. Tool shed and machine shed
4. Chicken house
5. Hay barn
6. Open cowshed
7. Pig house
8. Driveway

LARGE-SCALE OWNERSHIP

The pattern of agricultural organization is also much affected by the way in which the land is owned. In the patterns discussed above, the individual farm units are small family-operated units. In many sections of the world, a large fraction of the land is held in large ownerships, called by various names, such as *estates* (in Europe), *collectives* or *kolkhoz* (in Russia), *latifundia* (in old Rome especially), *haciendas* (in Latin America), *plantations* (in the Tropics and in the cotton states of the United States) or simply as large or large-scale farms.

The major differentiation within these is between operation as one large single unit from a central farmstead, and operation as many small units with separate farmsteads. The appearance of the agricultural landscape is affected greatly by the choice between these two types of organization. In the first case, large imposing farmsteads surrounded by the homes of the managers, and perhaps the cottages of the laborers, are spaced at wide distances. In the other, the owners are likely to live in cities or villages nearby, and the landscape to have much the appear-

ance of individual farm ownership except for much less variety in types of dwellings and farmsteads and sizes of units.

But more important than the effects of the landscape are the relations between the workers and management in these two types of organizations. Under the single-unit setup, the laborers work for wages, receive their orders each day and assume only the ordinary responsibilities of a hired laborer on a farm. The plantations in the cotton states of the United States were organized on this basis in the slavery period. The large plantations in the East and West Indies now operate mostly on this basis. An indenture system is used on many of the copra and cocoa plantations in Melanesia in the South Pacific. Native workers contract to work for two years. Varying proportions (often 50 per cent) of their money wages are retained by the operator until the end of the period and then turned over in a lump sum. Small amounts are paid to the workers at intervals along with allowances of tobacco, clay pipes, and calico.

The decentralized type of organization is illustrated by the plantation system that has developed in the South since 1865. The extent of decentralization of management varies considerably, however — at one extreme the families living on the individual units are simply hired laborers' families who work on the crops and care for the livestock, and at the other extreme are full-fledged cash tenants who own all of the livestock and equipment and assume most of the managerial and financial responsibility. On the plantations in the cotton-growing states today, the tenants are mainly "croppers," which is a name commonly applied when the landlord furnishes all the working capital. Although the cropper families live in small houses adjacent to the land they work, all the workstock and machinery is usually kept in the headquarters buildings. Any livestock except that owned personally by the cropper family also is kept at the central buildings. The work of the cropper families is usually directed very much like that of wage labor.

Much like the cropper system is the *métayage* system of Europe, best developed in France, under which the landlord, who sometimes lives on the estate, but is also often an absentee capitalist, furnishes the implements and livestock and receives half the product.

On the *haciendas* of Latin America, still another type of organization is frequently found. The families each have a small tract of land which they operate under their own management although they do not own it. The produce and income from this land goes entirely to this family. The *haciendados* or operator of the whole tract of land under one ownership has a central farm which he operates with the labor furnished by

the families on his estate in payment of the rent for their small tracts of land. They ordinarily work two or three days a week on the central farm. Some 80 to 90 per cent of all the land in the estate will be divided among the families in small tracts. The central farm is likely to consist mainly of arable land. This system, as we shall see later, follows very closely the pattern of the European manors during the feudal period. The Spanish grandees transplanted it to the New World, and it still survives. It disappeared in England with the breakdown of feudalism in 1550 to 1850.

On the large estates of old Rome, called *latifundia*, a variety of relationships existed at different periods, ranging from outright slavery on single-unit enterprises to tenant operation that in time developed into secure tenure rights. On some of the large estates, part of the land was farmed with slaves or hired labor and part of it by tenants.

Europe still has many large estates, especially in East Prussia and Poland. Many of these, however, were divided among smallholders in the several decades before World War I, and many more as an aftermath of that war. The prevailing type of operation on these estates is the single unit with hired labor.

The collective farm, or kolkhoz, is now the typical producing unit in Russia. The government owns the land which the members of the kolkhoz cultivate, but still the families for the most part live in villages and own their houses and gardens. Except in the livestock-producing areas, much of the livestock is kept on the individual homesteads in the villages, and is fed largely on fodder and pasture produced on the kolkhoz. The power and machinery are furnished by machine-tractor stations on a fee or custom basis, and operated by men trained in technical schools for this work. The members share to some extent in the management of the collectives and share in the product.

In parts of Europe, and to some extent in the United States, a system of *group management* of farms has developed. Under this, a professional farm manager or company takes over the overhead managerial functions of farms owned by different individuals. This system is so well developed in Germany that young men train themselves as professional farm managers in the agricultural schools. The census figures for Poland, Czechoslovakia, and Austria also indicate that many farms are operated by hired managers. The details to which the management is carried by such professionals varies considerably, ranging all the way, in this country, from providing the simplest of managerial services, and the working out of farm plans and the terms of leases, to virtually complete operation with hired labor, as in the case of citrus orchards in Florida

and California. Some of the insurance companies which became owners of farms through foreclosure in the United States in the interwar period have set up departments in their companies to handle the leasing and supervision of their farms.

Experiments with new types of large-scale farm organization are being tried somewhere all of the time. One such experiment, that of the Collins Farm Company of Cedar Rapids, Iowa, undertaken unfortunately while agriculture was still depressed, took the form of combining five to ten farms within a radius of five or six miles of a central point where the local manager lived and from which modern mechanized equipment went out to do work on the individual farms. The 1,200–1,500 acres operated from this central point were treated as one unit with one rotation system. This meant that all of the land in one of the farms would be in the same crop in any one year. The field fences were removed and all the ditches filled in so as to permit taking full advantage of mechanization.

A still more elaborate type of organization is that of the Walker-Gordon Farm at Plainsboro, New Jersey. This can properly be described as an *integrated* system of organization.[6] Part of the farms grow feed for the dairy herds on a contract at so much per ton or bushel. They, in turn, obtain their manure and supplies from the central management at a contract price. Other farms raise heifers for herd replacements at a contract price per pound of gain in weight, the central management furnishing the sires. The actual milking herd is broken up into units of a hundred and operated under contract prices for feed and milk produced. The milking is done in one central "milking parlor."

COMMUNAL FARMING

In the discussion of village organization early in the chapter, reference was made to the ownership, in the feudal period and before, of pastures and woodland in common, and to the strip allocation of the arable fields. These for the most part outlasted the passing of feudalism. Not until the Enclosure Movements and the coming of the capitalistic system did individual farm ownership and operation appear in England. On much of the continent of Europe, feudalism gave way to joint ownership and operation in strips of the arable lands, and common use of the pastures, meadows, and woodland. This was full communal ownership and use of the land. The arable fields were in most regions redistributed at intervals among the families according to their size. This system pre-

[6] *Integrated* or *vertical* organization, as distinguished from *horizontal*.

vailed in Russia for two hundred years, from the time of Peter the Great to the Revolution in 1917. The redistribution, under the rules laid down by Peter, could occur not oftener than every three years and must take place at least every nineteen years, which was changed later to twelve.

The Western Hemisphere was settled at a time when there was still much communal ownership in parts of Europe, although little in England. The only traces of such ownership that reappeared in the English settlements were some village commons, and a limited amount of common pasture land or undistributed woodland or waste. The French settlements, however, transplanted a good bit of manorialism to Quebec, and traces of this lingered in the colonies outside of New England until the time of the Revolution. The Dutch system, instituted in the colony of New Amsterdam, set up in 1629, gave a tract of land to any "patroon" who brought in fifty families which he was to rule like a feudal lord. This system spread all over the Hudson River Valley and was entirely abolished only in 1846, by changing the state constitution. In fact, the agitation over the Dutch system was a principal reason for the calling of a state convention to revise the state constitution.

The Spaniards contributed the most to communal ownership in America. Landholding villages were set up in Mexico patterned after villages in Castile in Spain. These had two classes of lands, the arable lands worked in common or by rotation, for which rent was paid to the village, and the common pastures and woodlands. Just outside the village was also a tract of common land, called the "ejido" (pronounced ā-hēēd-dō) used for various public purposes — threshing floors, slaughter pens, etc. But the native Indians also had communal ownership. They held their hunting lands in common, and the more civilized of them — the Aztecs and Mayas — worked their cropland as a unit. The village that finally emerged in the Spanish territories was an amalgamation of the Spanish and the Indian prototypes. The croplands tended to be held in separate family tracts, but could not be alienated. The pasture and woodland were kept in common, the ejido being expanded to include these.

Over the centuries, however, the Spanish grandees have encroached on these communal holdings, and, by one device or another, brought them within their haciendas. Nevertheless, some land in Mexico, Central America, Ecuador, Peru, and Bolivia is still held by the Indians in common ownership. It is located mostly in pockets in the mountain regions and in the less fertile areas. One large block of such land is upon the high cold plateau of Bolivia called the Altiplano. In some cases,

the cropland is redistributed at intervals, but in others is held indefinitely by one family. Still, the land is thought of as belonging to all, and cannot be alienated. If a family stops using it, it is assigned by the village to some other family. In Central America, the village frequently holds a reserve of timberland, and from this land, or land given up by other families, assignments are made to new families. In parts of Bolivia and Peru, some of the land in the haciendas is operated in collective units — Indian villages within the haciendas.

The essential feature of the Mexican land reforms introduced from 1915 on is to restore to the villages, by expropriation from the estates, enough good farming land to enable the families of the village to make a living for themselves. To this tract of land, the name of ejido is applied. The ejido of modern Mexico therefore includes arable land first of all. At one stage of the land reforms, 1922–1930, the program called for farming the arable land as a unit, the workers sharing in the crop in proportion to days of work. The idea was to abolish small-scale hand agriculture and take advantage of modern machinery. But in actual practice the land was allotted to individual families in most ejidos, and in new legislation passed in 1930 the village lands were divided into: (a) municipal land, used for schools, etc., (b) pasture and woodland, owned in common, (c) other units requiring collective handling, and (d) the arable lands parceled out to the separate families. These cannot be sold or rented, but they are heritable. If not enough land is available to give all the families a basis for a living, additional land is to be provided by clearing, irrigation, or further expropriation. The plans are to have the buying and selling done cooperatively, and also to own the larger types of farm machinery in common.

OUTSIDE THE FARM

As agriculture is more than the producing of farm products, so must the organization of agriculture reach beyond the individual farm and include marketing and credit facilities and other types of services both public and private.

MARKETING The conventional pattern of organization for the marketing of farm products is a local market where the products are assembled in carlots, then transported by rail to central markets where wholesale receivers of various kinds act as intermediaries between them and the processors; and beyond the processors, more transportation, and the jobbers and retailers. Somewhere along this line there may be considerable storage. The part of this chain which is nearest to the farmer is

clearly a part of the organization of agriculture. The marketing activities of the farmers and of the first receivers may overlap. For example, some farmers sell their livestock direct to private buyers who forward it to commission firms in the central market, and some to buyers sent out by meat-packing firms, but others truck their livestock directly to central markets. Around the large cities, most farmers sell their milk to distributors and their eggs to local stores or to country buyers. But around villages and smaller cities, they commonly distribute their milk and often some of their eggs direct to city homes. In the public markets that are common in the South, and still more common in the Old World and in much of Latin America, the farmers sell their products directly to consumers. In the large produce markets found in large cities, the farmers sell mostly to retailers.

The principal departure from the conventional pattern of marketing organization in the United States occurs when processing establishments, like creameries, cheese factories, milk condenseries, canning factories, slaughtering plants, flour mills, wineries, and sawmills are located close to the farms, so that produce is hauled directly to them. Also, some processing, such as of butter and cheese, has remained on farms, especially on the larger farms, and some farms combine processing for their neighbors with farming. Thus, the 1930 Census of Agriculture of Austria reported 17,500 farms with flour mills, 21,100 with distilleries, and 3,000 with sawmills.

Paralleling organization for the disposal of farm products is an equally important chain of marketing agencies for supplying farm families with the goods used in family living, and farms with the materials used in production — feed, fertilizer, lumber, farm machinery, spray materials, crates, boxes, sacks, and other containers. Local markets serve as sources of these rather more often than as outlets for farm products. The principal exception is direct buying through mail-order houses.

FINANCE In most countries, the organization of credit for agriculture is a complex of private, cooperative, and public agencies. The private agencies in the United States for furnishing long-term credit are the local banks, the farm mortgage companies, and the insurance companies; and many farmers get their mortgage credit directly from relatives and friends. The private sources of short-term credit are the local banks, the local merchants, and the farm machinery and fertilizer companies. Merchant credit is still widely used in the South, but is declining in importance. Public agencies for supplying long-term credit in 1944 were the Farm Credit Administration and the Farm Ownership Division of the Farm

Security Administration. The Farm Credit Administration was supplying short-term credit through its production credit associations and its emergency seed and feed loans, and the Farm Security Administration through its so-called rehabilitation loans. Insurance, the other important phase of agricultural financing, is supplied by cooperatives as well as by private and public agencies.

COOPERATIVES

The many small farms in the United States, and still larger numbers of them in Europe, are handicapped greatly in the buying and selling and financing phases of their businesses. The farm operator who does chores morning and night, and works in the field all day between, does not have much time or energy for these, nor is he likely to have the specialized skill needed. Selling one load of hogs at a time calls for the same skill and attention as selling five; and buying one ton of dairy feed, the same as buying ten. Small farms are fully as much handicapped in production. It may be more important for the small farmer to breed his five cows to a good sire than for the large farmer. Also, small farms do not provide enough work to use many types of farm equipment economically. This is particularly true of the power types of equipment that save so much backbreaking labor. The manufacturers are making smaller units, but even the smallest of them cost too much for many small farmers.

The most obvious way of overcoming these handicaps is to have large farms. But these introduce other difficulties. The form of organization which has made most headway is a combination of *cooperative* or *group* operation with individual farm operation. In production, this takes the form of joint ownership and operation of many types of farm machines; both of the types that can be moved from farm to farm, like tractors and tractor combines, terracing equipment, and silo-filling outfits; and of the stationary types, like cotton gins and butter- and cheese-making equipment. One can expect many of the coming cotton pickers to be owned in this way. Joint use of such equipment by groups of farmers raises difficult problems of human relations, but these can be overcome to the great benefit of all concerned. Other types of cooperation in production are joint ownership and use of sires, including a growing use of artificial insemination methods and cow-testing associations. In the Western states, cooperative irrigation companies have functioned almost since the beginning.

It is in buying and selling that cooperation has made most headway

in the United States. Successful methods of cooperation have been developed for most types of farm products. The most rapid progress in cooperation in recent decades has been in purchasing. This growth is in part explained by the emphasis placed on providing the farmers with types of feed rations, fertilizer, and equipment suited to their particular needs.

Cooperative credit is more important than cooperative buying and selling in most of the countries of Europe and Asia. The credit unions serve a very great need among families with low incomes living on small tracts of land. In the United States, certain cooperative features have been introduced into some of the publicly sponsored agencies like the Farm Credit Administration. However, the local bank, which is the indigenous type of local credit institution in the United States, has never been adapted to farmer cooperation. Insurance, on the other hand, has proved to be a very successful type of cooperative activity in the rural districts of this country. A major fraction of the property insurance of the farmers of the United States is carried by farmers' mutuals. In the field of services, the first important development in this country was the rural telephone. Recently, the cooperative form of organization has been adapted to the needs of rural electrification.

PUBLIC ORGANIZATION

The activities of modern life which public agencies in general are best able to perform are too well recognized to need discussion. They include national defense, police protection, fire protection, highways and streets, weather forecasting, public health, education, research, etc. It has been customary to classify the public activities in agriculture under four heads — *education*, *research*, *regulation*, and *services*. Under education, special mention is needed here only of adult education or extension. This is a response to the need for getting agricultural improvements adopted more promptly than by waiting until the school children have grown up and become farmers. By that time, new developments will frequently have taken place which outmode what was taught in the schools. Scientific improvements in agriculture are likely to be adopted very promptly on large farms. Travelers in Russia before the First World War reported with amazement the high type of agriculture practiced on the large estates of Russia. Soil and plant science had made as much progress in Russia as in any other country, and what the scientists had discovered was being applied by the managers of these estates. The peasants of Russia, farming their little strips spread out around the villages, knew nothing whatever about these discoveries of science. In

fact, many of them were still using their cow manure in dried form for fuel. As long as agriculture is organized mainly in small units, some program of education is needed which will reach the many individual operators. The agricultural extension service of this country was developed mainly to meet this situation. Many other countries also have some form of adult education for rural people.

The need for public participation in research is even clearer than in the case of education. One cannot expect individual farmers, working long hours in the field, to conduct much laboratory research or to carry on elaborate plot experiments. Individual farmers can assist research by trying out new methods and new varieties under actual farming conditions, but this is about as far as they can go. In this country, and many others, national and state or provincial governments have set up experiment stations which have contributed much to agriculture in the last fifty years.

In many ways the services now offered to farmers are the most important of the four types of public activities. These include a very wide range of activities, such as supplying the farmers with information about market prices, market receipts, and prospective supplies and demand; the testing of seeds, feed, fertilizer, soils, etc.; the furnishing of credit, including the servicing of loans.

The county agent, although classified as an educational functionary, devotes a good deal of his time to rendering services of various kinds. It is difficult, as a matter of fact, to draw any clear line between adult education and services. The dairy herd improvement associations in the United States combine the service of testing dairy cows with education in better feeding and dairy management. The Agricultural Extension Service furnishes the general guidance and direction for these associations, but the actual testing is paid for by the farmers receiving it. The county agent in England is called the county organizer.

Public protection against diseases and pests is necessary because the individual farmer is helpless against the indifference of a few of his neighbors. Police power needs to be exercised against a few who will not themselves take the necessary preventive and control measures. A somewhat parallel case arises in the protection of the quality of farm products. The government of Denmark stepped in for this reason to protect its producers of butter, bacon, and other products. The Canadians imposed similar standards on exports of bacon. The potato growers of Maine are now struggling with this problem, forced to do so by the growing preference of the consumers of the East for carefully graded and packed Idaho potatoes.

Some of the recent large-scale national programs in the United States, like that of the Agricultural Adjustment Administration, combine services and regulation. They serve agriculture by developing national, regional, and local production plans and by assisting the farmers in carrying out these plans. They exercise police power by bringing pressure to bear on those who do not participate in the programs. The Soil Conservation Service combines education, research, and servicing with a limited amount of police power. The warehouse inspection service is a combination of policing and servicing warehouse certificates. The inspection of cooperatives, well developed in other countries, is a combination of education, service, and policing.

FURTHER READING

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EXERCISES

1. Make a map of several square miles of land in your area showing how it is divided between owners and then undertake to explain how it acquired its present general pattern. (Maps of farm boundaries, roads, etc., by counties are available in plat books in most university or college libraries.)
2. Draw a rectangular survey township, using the scale 2 inches equals 1 mile. Lay out and number the sections. Divide section 12 into quarter sections. Shade in the southwest one fourth of section number 12. (Use a plat book for reference.)
3. Cite examples of divided holdings in your home area.
4. How well are the farms in your home area balanced as to combinations of plowland, pasture, meadow, and woodland?
5. Describe the composition of one or more of the hamlets in your home area.
6. Are there any lands, other than roads and streets, in your home territory which are not in private ownership? How are they owned?

7. What products raised in your home community are: Sold at a local market or to local merchants; trucked directly to central markets; sold directly by farmers to consumers; sold directly to local processing plants; sold to farmer-owned cooperatives?
8. List all the examples of cooperation in production, buying and selling, credit, insurance, etc., that are found in your area.
9. What state and local regulations are the farmers in your area subject to? What federal regulations? What services to farmers are provided by state agencies? by federal agencies?

CHAPTER III

The Farms

THE NEXT STEP IN OUR ANALYSIS IS TO OBTAIN A CLEAR CONCEPTION of the nature of the farm which is the prevailing unit in agriculture in the United States and in much of the rest of the world. Three general propositions need to be made about this farm at the outset:

First, it is a *producing* unit. It may be that everything produced on the farm is consumed by those who produce it, as is true with so-called pure *self-sufficing* farming. Still, unless it produces, it is not a farm.

Second, it is a *business* unit, just as much as is a factory, railroad, store, or bank, with the same kinds of *assets* and *liabilities* as these. If it has any net income, it is subject to a business tax like any other business.

Third, it is a *legal* unit, with the same kinds of contractual relations as these.

THE FARM AS A BUSINESS UNIT

The business-unit character of a farm is made more evident if one draws up a balance sheet for a farm exactly as one would do for a factory, with its assets and liabilities, the difference between these assets and liabilities being the *net worth* or *proprietorship* of the business. The balance sheet of a farm business, on page 40, may be taken as representative.

This farmer, Henry Green, is operating a business enterprise with a capital investment of $15,800; but $4,750 of this capital is not his own. It has been invested in the business by others at a fixed rate of return, as if it were bonded debt.

A year later, another balance sheet can be constructed and the change in net worth will show the profit or loss on the year's business. Let us suppose that it is a successful year's business, and that Green reduces his notes to $50, pays $200 on his mortgage, pays $210 cash for a purebred sire; that his livestock increases $350 in value, counting the sire purchased; his feed inventory, $160; and his cash on hand (bank

account), $220. Offsetting these gains, there will be a depreciation of his equipment and farm buildings, let us say, equal to $200. This farm business will then show, on December 31, 1946, a net worth $880 larger than a year earlier.

HENRY GREEN

BALANCE SHEET, *December 31, 1945*

Assets			
CASH ON HAND		$ 120	
ACCOUNTS RECEIVABLE			
Notes receivable	$ 150		
Uncollected bills	30		
		180	
INVENTORY			
Farm	10,500		
Livestock	2,200		
Equipment	1,550		
Feed and supplies	1,250		
		15,500	
Total Assets			$15,800
Liabilities			
ACCOUNTS PAYABLE			
Mortgage on farm	4,500		
Notes payable	200		
Unpaid bills	50		
		4,750	
Total Liabilities			4,750
Net Worth			
HENRY GREEN, CAPITAL			$11,050

A good businessman not only determines his net worth each year, but also works out an Operating Statement — sometimes called a Profit and Loss Statement — which shows in detail his receipts and expenditures during the year. This helps him analyze his business more carefully. If the balance sheet and operating statements are both made correctly, the profit and loss shown upon the operating statement will be the same as the change in net worth between the two balance sheets, except that allowance must be made for additional investments in the business and withdrawals of capital. The following may be taken as a representative operating statement for Henry Green's farm. Profit or Loss is here called Net Business Gain or Loss to keep it from being confused with profit or loss in the restricted sense in which these terms are used in economics. What we are thinking of here are profits or losses in the accounting sense. They include return to the farm operator and his family for their

labor and management and for the use of any capital which they have invested in their business.

HENRY GREEN

OPERATING STATEMENT
FOR THE YEAR ENDING *December 31, 1946*

RECEIPTS				
Sale of cream		$1,650		
Sale of cattle and calves		420		
Sale of hogs		430		
Sale of poultry and eggs		220		
Sale of crops		300		
Labor off the farm		60		
Total receipts			$3,080	
INVENTORY				
Livestock				
December 31, 1945	$2,200			
December 31, 1946	2,550			
Gain or loss		350		
Feed and supplies				
December 31, 1945	1,250			
December 31, 1946	1,410			
Gain or loss		160		
Farm, buildings and equipment				
December 31, 1945	1,550			
December 31, 1946	1,350			
Gain or loss		− 200		
Total inventory gain or loss			310	
EXPENSES				
Feed purchased		310		
Other supplies purchased		120		
Sire purchased		210		
Labor		640		
Repairs		60		
Taxes		210		
Interest		250		
Insurance		70		
Miscellaneous		50		
Total expenses			1,920	
Net Business Gain				$1,470

DISPOSITION OF NET INCOME

Paid on mortgage	$200	
Paid on notes payable	150	
Addition to bank account	220	
Withdrew for use of family	900	
		$1,470

This farmer made a Net Business Gain of $1,470 on his 1946 farm business, this resulting from receipts of $3,080 and an inventory gain of $350, less operating expenses of $1,920. He diverted $900 of this $1,470 to the use of the farm family outside of the farm business, put $220 into the farm bank account, and used the rest in reducing his mortgage and other debt.

FARMS AS LEGAL UNITS

The principal distinction that needs to be made under this head is among farms as *one-man* enterprises, as *partnerships*, and as *corporations*. No separate census of agricultural corporations in this country has ever been made — perhaps there are ten thousand of them. Probably fewer than a hundred thousand are partnerships. Most partnerships in agriculture are family arrangements — brothers, brother and brother-in-law, or father and son. Nevertheless, all the legal relationships and responsibilities of business partnerships pertain. This means that each partner has an equal right in the direction of the business and has power to bind the partnership by his acts, and that each member is liable for all the debts and obligations of the partnership firm. There may be an understanding within the partnership as to what duties each is to perform, but to the outside world, each is responsible for the commitments of the other insofar as they relate to the business. And, as with one-man business units, except for the special exemptions provided for farmers in some states, all the property of each can be attached to redeem the debts and other obligations of the enterprise.[1]

With the ordinary corporation, on the other hand, the stockholders are liable only to the extent of their investment in the business. Corporations came into existence as a means of raising the funds needed to finance a larger business than one man can ordinarily finance alone, or even two or three partners. The individual stockholders in a corporation, moreover, do not run any part of a corporation directly; they merely vote on matters of general policy and programs and help elect officers who run the business, often through a hired manager. The corporation, of course, may have perpetual life — the stockholders change, but not the corporation; whereas a partnership ceases whenever any member dies or withdraws.

If Henry Green's farm business were a corporation instead of a one-man unit, the balance sheet would look exactly like the one shown,

[1] Some state laws permit "limited partnerships" provided this is clearly indicated in the partnership agreement.

except that stocks and bonds would appear as the liabilities instead of the mortgage. The operating statement would differ only in that the amounts distributed as dividends to stockholders would appear in the disposition of the income. There would be no problem in this case of keeping separate the accounts of the corporation and the personal accounts of the manager of the farm or the treasurer of the corporation. It is not easy to do this with a one-man family farm business unless separate bank accounts are kept, but it is just as necessary if the farmer is to know where his business stands. Unless the farm and personal accounts of partners are kept separate, dissolution of the partnership is the likely outcome. Any cash taken out of the business by any partner, or paid into it, must appear in the records and in the Net Business Gain and distribution statements.

A FARM AS A STATISTICAL UNIT

The moment one starts counting the number of farms in an area, a state, or province, or country, or making any statements about these farms, one has to decide just what is a farm. How about the piece of woodland up the road where Sam Hubbard pastures a cow or two, but mostly sells cordwood to families in town? How about the little garden and pasture lot where the mail carrier keeps a family cow? One can easily imagine the difficulties the federal census encounters in collecting data on all the farms in this country. The definition which the census enumerators is this country are expected to follow classifies as a farm *any tract or tracts of land operated under one management, of three acres or more, upon which agricultural operations are conducted, or of less than three acres if the year's value of the farm products is $250 or over.* The enumerators, however, have usually failed to count large numbers of part-time farms that qualify under this definition. On the other hand, they have counted as farms a good many places with more than three acres of land but with very little farming. The net effect of these two offsetting influences has been too low a count.

The count was particularly low in the 1930 census because the instructions for the census of population, taken at the same time by the same enumerators, carried a statement that a family was not to be considered as a farm family unless the place "*was locally regarded as a farm in the community.*" At least 200,000 more farms were omitted than in prior censuses. In 1935, the instructions ran the other way, and the number of farms reported by the census rose from 6,289,000 to 6,812,000, even after many thousands of schedules were thrown out in the tabulation. Not even in

1935, however, were all the farms counted that qualify under the definition. In 1940, the instructions were like those of 1910 and 1920, and the number of farms fell off to 6,097,000. In the state of Connecticut, which has much part-time farming, the census counts shifted in 1930, 1935, and 1940 from 17,200 to 32,300 to 21,200. Thus, the number of farms reported by the census since 1920 has changed much more than the actual number of farms.

In Great Britain, Canada, and the other British Empire countries, the lower limit on size is usually one acre. The Canadians add: "or $50 of value of product." The countries on the Continent of Europe set limits ranging from an eighth of an acre (Netherlands and Austria), to a quarter of a hectare in Switzerland and Finland, to a half hectare in Germany and Belgium.[2] Thus the reported figures on number of farms and average size of farms for different countries cannot be compared. Three quarters of the "holdings" of Belgium contain less than one hectare, two thirds of those of Germany, and a fourth of those of France and Czechoslovakia.

CLASSIFICATION OF FARMS

Farms also differ so much that figures representing totals and averages for all in a country or province are not very meaningful. Censuses commonly classify them in various ways such as according to size measured in acres, or value of products, or tenure, or crops and livestock produced. The 1940 census of the United States made a classification according to major source of income. Thus, a farm was called a cotton farm if more of its gross income came from cotton than from any other source. The 1930 census made a more careful classification according to "type of farm" in which other factors besides source of income were taken into account. Also, if a farm did not obtain so much as 40 per cent of its income from any one source, it was classified as a "general" farm in 1930. Many of the general farms were classified as "livestock" in 1940. Table 1 gives the numbers in the different classes in these two censuses. (Note that the censuses covered the production of the preceding years.) The omission of many self-sufficing and part-time farms in the 1930 census is clearly evident.

The term *crop-specialty* was introduced in the 1930 census to include a large list of individual products such as sugar cane, sugar beets, soybeans, field peas and beans, tobacco, hay, peanuts, potatoes, hops, broomcorn, and so forth. *Stock-ranch* farms were those devoted mainly

[2] One hectare equals 2.5 acres.

to grazing. The term *animal-specialty* was applied to farms specializing in the fattening of livestock such as hogs, beef cattle, and lambs. About a third of the farms failed to fit within the commodity groupings thus liberally defined. The term *general* was introduced to include those whose value of product from any one source was less than 40 per cent; *self-sufficing*, to take care of those which produced less for the market than for the use of the farm family, the dividing line being placed at 50 per cent; and *part-time*, those whose operators worked off the farm 150 days or more and had less than $750 of income from farm products.[3] Those called *miscellaneous* in Table 1 are designated in the 1930 census as country estates, institutional farms, feedlot farms, and boarding and lodging farms.

TABLE 1. CLASSIFICATION OF FARMS IN THE UNITED STATES CENSUSES OF 1930 AND 1940

1929			1939	
Type of farm			*Major source of income*	
Cotton	1,640,000			
Crop-specialty	431,400	=	Field crops	2,187,000
Cash-grain	454,700			
Truck	84,600	=	Vegetables	80,100
Fruit	141,400	=	Fruit and nuts	133,700
Dairy	604,800	=	Dairy	619,000
Poultry	166,500	=	Poultry	217,600
Animal-specialty	479,000	=	Livestock	726,000
Stock ranch	71,000		Other livestock products	20,300
Forest products	20,100	=	Forest products	23,300
Self-sufficing	1,044,300	=	Farm produce used by household	1,942,700
			Horticultural specialties	19,000
Part-time	339,000			
General	384,000			
Miscellaneous	25,200			
Total number classified	5,886,000		*Total number classified*	5,968,700

Source: Census of 1940, Agriculture, Volume III, General Report, p. 882. The table does not include the farms which had no income or failed to report one.

[3] There was much dispute over the term "self-sufficing." Some said that it was not proper to use it unless the farm was completely self-sufficing, and suggested "subsistence" as an alternative. This was objected to, however, on the ground that it carried the implication that the families on these farms merely "subsisted." Probably a better term would have been "family-living farms."

The Department of Agriculture and the Bureau of the Census have been working out a further classification for the 1945 census, which will take a form somewhat like that in Table 2. This classification is in terms of value of farms as well as gross incomes, since in the particular year in which the census is taken the income may be low because of crop failure or for other reasons.

TABLE 2. PROBABLE GENERAL FORM OF THE 1945 CENSUS CLASSIFICATION OF FARMS

	Probable number in 1940
1. Multiple-unit farms — farms having two or more subunits, one of which must be a cropper or tenant subunit handled as a single farm enterprise under the close supervision of the multiple-unit operator. This classification will include the Southern plantations and could also include the much smaller number of so-called chain-farming units in other sections of the country	30,000
2. Large-scale farms — income (gross) of $20,000 or more, or worth $70,000 or more. This class includes farms so large that the operator ordinarily does nothing but manage	70,000
3 Middle-scale farms. These are working-operator commercial farms — that is, farms on which the operator combines work and management	2,900,000
(a) Large — income from $8,000 to $20,000, or worth $30,000 to $70,000	300,000
(b) Medium — income from $3,000 to $8,000, or worth $20,000 to $30,000	1,200,000
(c) Small — income from $1,500 to $3,000, or worth $10,000 to $20,000	1,400,000
4. Small-scale farms	
(a) Smallholdings — income under $1,500 with operator working off the farm less than 100 days. Many of these farms are highly commercial cotton or tobacco farms and the like	1,200,000
(b) Part-time farms — income under $1,500 with operator working off the farm 100 days or more	700,000
(c) Residential and other "nominal" farms — income from farm production of $500 or less, and working off the farm less than 100 days. This class includes places occupied by families with income from pensions and other sources outside their farms other than work, but also many low-income "subsistence" farms	650,000

Source: The joint committee of the Census Bureau and the U. S. Department of Agriculture.

If the data concerning the farms of the United States are given in terms of these eight groups and subgroups, clearly they will be much more informative than when grouped only according to the source of income. Even then, they will not all be significant as national averages because a cotton farm with a labor force the equivalent of two men may have only a fourth of the income of a wheat farm with the same labor force. State and county averages on this basis would be much more significant, especially those which subclassified source-of-income groups in this way.

MULTIPLE-UNIT FARMS

Let us now consider briefly the more important of the classes of farms listed in Table 2. The cotton plantations of the South make up most of the multiple-unit farms of the United States. A special census in 1910 enumerated 33,900 cotton plantations in seven states. We shall have to wait for the 1945 census to know how their numbers have changed since. They are distributed all over the South, but are strongly concentrated in certain sections. In the Mississippi-Yazoo Delta, 89 per cent of the farm land was operated under the plantation system in 1930; and the proportion was nearly as high elsewhere in the bottom lands of the Mississippi and tributary streams as far north as the "bootheel" of southeast Missouri. The plantation system is no longer dominant as it once was in the Black Prairie of Alabama and Mississippi, and in the Brown Loam area of Mississippi. The plantation areas of the Southeast are now mostly in the Upper Coastal Plain of the Carolinas and Georgia. There is clear evidence that outside of the Delta, the larger plantations operating a thousand or more acres of cropland with thirty or more families are much less common than in earlier years, and the differences between small plantations and large farms are not very important today.

The larger plantations continue to be distinctive in that they commonly have commissaries where the cropper families do their buying, mainly on credit advanced by the landlord till the crop is harvested.

Also, outside the distinctly plantation cotton areas, and in the tobacco areas of the border states, there are many units with one or two cropper families who grow a small patch of cotton or tobacco on shares, and work for the owner-operator for the rest of their income.

LARGE-SCALE FARMS

We may get some idea of the extent of large-scale operation of farms in this country from the following data on hired labor force on the farms of the United States in the first week of January, 1935:

NUMBER OF FARMS HIRING [4]

No laborers	5,844,700	6 laborers	8,200
1 laborer	722,600	7 laborers	3,700
2 laborers	137,700	8 laborers	3,800
3 laborers	43,500	9 laborers	1,600
4 laborers	22,500	10 or more	11,400
5 laborers	12,500	Total	6,812,200

[4] It will be remembered that the 1935 census reported an unusual number of part-time and other small farms.

If the farms hiring three laborers or more in January are large-scale farms, there were 107,000 of these in the United States in 1935. Apparently this was about the division point sought in the 1945 census classification. The farms thus classified as large-scale were employing almost two fifths of the regular hired farm labor, and farming about a fifth of the land.

The operators of this group of farms have little time for any manual labor. They must devote much of their attention to the buying and selling and financing parts of the farm business. When they are in the field, they are directing the labor force. With four or more men to supervise, and the equipment and livestock that go with these laborers, they have little time for anything else.

When farm operations reach the scale represented by ten workers, specialization in management itself is likely to appear. One assistant manager or foreman may have charge of the field operations and another of the livestock; or the differentiation in management may be what is called "functional"; that is, one looks after the buying and selling, another the production, another the record-keeping and accounts, and perhaps still another keeps the equipment in a good state of repair. If the tract of land is large, it may be desirable to break it up into sections each with its own operating center where the workstock and equipment are kept and the workers are housed. In this case, the assistant managers will have charge of the different sectional units just as a regiment in the army is broken down into companies each with a captain in charge.

The Russian collective farms, or kolkhozes, vary in size depending on the kind of farming carried on and several other factors. In 1938 the average kolkhoz had 78 households and over 1,200 acres of cultivated land. Each family, in addition, has a small household, usually not over 2.5 acres, on which it may keep a cow, chickens, and pigs, and grow its garden produce. These farms are directed by a chairman elected by the members in consultation with an executive committee also elected by the membership. They must be operated, however, within the over-all plans for the agricultural production in the region developed by the government. The government also determines the prices to be received for the various products and the amount that must be sold through government channels.

FAMILY FARMS

We still have nearly six million farms in this country after taking out the 30,000 multiple-unit farms and 70,000 large-scale farms. These are

family farms in the ordinary loose sense of the term; they are farms whose organization is mainly determined by the proprietor and family labor available and not by the use of hired labor. In practice, if more than two or three men are hired for the year or crop season, the use of the hired labor begins to dominate the organization and it loses its family character. These are also mostly worker-operator farms in that the operator works along with the hired labor, and on a majority of them, does most of the work himself.

To a very pronounced degree, a family farm is a family unit as well as a business unit. The organization of the farm, its management, its buying and selling, and above all its financing are different because the farm and the family exist and function together. The business units that are most like family farms in this respect are the retail stores run as family enterprises — sometimes jocularly referred to as "papa and mama" stores. When a business and the lives of those engaged in it are thus closely intermingled, they cannot really be separated one from the other. An artificial kind of separation can be made, it is true — for example, treating a farm dwelling or the garden as if it were not part of the farm — but as often as not a managerial decision to be made is more confused than clarified by this separation.

FAMILY-SIZE FARMS But although the six million remaining farms in this country may be loosely called family farms, they are not all family-size farms — that is, a farm large enough to utilize just the labor of an average-size farm family in the area. Part of the six million are either too large or too small for family-size farms. In the United States in 1940, the average farm employed 1.4 units of operator and family labor. This was the size of the average family-size farm measured in terms of number of workers as distinguished from acres or some similar measure. This average size varied a little by states because the families have more children in some states than in others, and because more members of the family do farm work in some than in others. But no doubt most of the 300,000 farms in Table 2 with incomes from $8,000 to $20,000 in 1940 (or worth $30,000 to $70,000) were larger than family-size, and likewise part of those in the next lower group, $3,000 to $8,000. There were 1,010,000 farms in this country which in January, 1935, were hiring one or more laborers. Probably three fourths of these were larger than family-size farms. In practice, in the actual classification of farms, those which hire extra labor for the short peak-load periods, but handle the regular work with the family labor force, are also called family-size farms.

It should be clear from this discussion that the terms *family farm* and *family-size farm* should not be used interchangeably. The term *family-type* farm also sometimes used must refer to the first.

FAMILY LABOR The 6,097,000 farms in the United States in 1940 had in the last week of March of that year, besides their proprietors and managers, 1,165,000 members of farm families working on the home farms, as compared with 1,925,000 hired laborers. About a fifth of the family workers were females and half of them were under twenty years of age. A large fraction of these family workers only help out with the chores nights and mornings or with certain operations like picking cotton or harvesting tobacco. They go to school five days a week during the school months. Some are even away from home at school except in the summer. The women and the girls who help with the farm work combine it with their housekeeping duties. They do their daily housekeeping after the morning chores, and their house cleaning at times of the year when the farm work is not pressing.

We have already noted that in many of the countries of Europe, more females than males are employed on the farms. This is especially true of the family workers. In Austria, for example, three times as many family workers are female as male. The male members of the family take jobs in the cities, mines, and forests. This is in sharp contrast with the United States where the daughters of the farm families are more likely to look for jobs in the cities than the sons.

FAMILY LIVING FROM THE FARM We have seen how important in most of the world the family is to the farm business. Equally important to the family are the materials provided for its use by the farm — the food, fuel, and still in many parts of the world, clothing. In a few remote areas in the United States, and in the interior portions of Quebec and the Maritime Provinces of Canada, the spinning wheel and the loom are still part of the family equipment. The data in Table 3 indicate that if housing is included, 43 per cent of the living of farm families in the United States between 1929 and 1942 was obtained from the farm, even when valuing these products at what farmers sell them for. If farm families had to buy them, they would cost much more than this.

The food consumed by farm families is partly grown for this purpose and partly taken out of the supplies that otherwise would be sold. In either case, a definite conflict arises; in the first, between getting the farm work done and getting the family garden cared for; and in the other, between desire for cash income and supplying the family with proper amounts of meat, milk, cream, eggs, and other foods that are

essential to good diets. This conflict is altogether too frequently resolved in favor of the farm work and more cash income. On many of the dairy farms in the United States, cream is still considered so much of a luxury that only occasionally is any of it used by the family.

TABLE 3. NET FARM INCOME FROM SALE OF FARM PRODUCTS, AND VALUE OF HOUSING AND HOME-PRODUCED PRODUCTS CONSUMED BY FARM FAMILY, UNITED STATES 1929–1942

Year	*Net income from products sold*	*Value of home-used products and housing* [a]
1929	$ 533	$402
1930	314	376
1931	139	314
1932	32	255
1933	149	240
1934	203	252
1935	377	284
1936	410	300
1937	507	319
1938	375	303
1939	428	303
1940	452	311
1941	741	345
1942	1,268	402

Source: *Agricultural Statistics*, 1943, Tables 493 and 495.
[a] Products valued at selling price at the farm.

Similar connections between the farm and family are the boarding and lodging of the hired farm laborers with the family and the common use of automobiles and other vehicles by the farm business and by the family. The family shopping and the farm buying and selling are very frequently combined in the same trip.

COMPETITION FOR USE OF INCOME Although the foregoing connections between the farm and family activities are very obvious, they are not the really important ones. The farm and family become most closely involved because of the choices that need to be made between use of income and of other resources in developing the farm and in providing adequately for the education, health, comfort, recreation, and leisure of members of the farm family. Shall the family buy a new electric refrigerator, or shall the farm buy a new machine? The care of the children's teeth may be neglected in order to accumulate enough money to purchase a self-binder. Hospital treatment that the mother of the family may need is sacrificed in order to see a crop through to the harvest.

Children may be kept out of school in order to get the crop planted or harvested. The boys are not sent to high school because the family does not think it can afford to engage a hired man to do the work.

Often there is competition between more income and more leisure. Shall the family expand the dairy enterprise, working perhaps an hour longer each day, and thus obtain more income? Many families will decide that the extra work is not worth while; others, spurred on by the need for added income to pay for some item of family living, will undertake the extra work for the extra income.

Capital accumulation and savings in agriculture commonly take the form of increase in inventories of livestock and equipment and improvement of land and buildings. If any cash income is left over, it is likely to go toward reducing the mortgage. Saving thus results without the special inducements that many wage workers need. But also in consequence, few farm families buy enough life insurance. Even though a family may be accumulating wealth at the rate of $1,000 a year, it is not protected against the untimely death of the head of the family.

The family owning its farm may make plans which require several years to complete because it expects to be on the farm when they bear fruit. Though many tenant families do in fact remain on the same farm year after year, they cannot be at all sure that they will do so under most of the leases now in use in the United States; and are therefore less willing to adopt soil-building cropping systems or to improve the farm home. The croppers of the South do not even have farm property in which to accumulate their savings. Although on the better managed plantations, they remain on the same farms year after year, they save very little. Many of those who know the South best say that the fault is with the people — they have never learned to save. Others will say that they never will learn to save under the cropper system.

FARMING AS A MODE OF LIVING These important connections between the farm business and the family living are ordinarily summed up in the statement that farming is a mode of life as well as a business. Some go so far as to say that it is a mode of life and not a business. There cannot be the close intermingling of the two lines of activities which make up about all of the lives of farm people without each exerting a great influence upon the other. One hears frequent discussion of the standards of living of particular population groups. On the farm, what may be called the *standards of work*, or the working conditions, are almost as much a part of life as the food, clothing, shelter, education, and recreation of the family. A change which makes the farm work less onerous

and less confining is as important a contribution to the welfare of the farm family as one which makes the income go farther in buying groceries, clothing, and education.

A large part of the satisfactions which make up life — to which economists nowadays ordinarily apply the term "utilities" — come not from acts of direct consumption — that is, from the eating of food or the wearing of clothing — but from the pleasure that one obtains from one's work. It is usual to illustrate this by the satisfaction which an artist derives from his painting or from his singing. The satisfaction which a farm family derives from the caring for crops and livestock and watching them grow and develop is as genuine as that derived by the people who are called artists. In the aggregate, no doubt, a much larger part of the pleasure derived from art in the world at large is obtained by men and women engaged in useful work, to whom the satisfaction in their work is only an incident, than is obtained by the few persons technically classified as artists and devoting their lives to producing pure works of art. And agriculture provides more of such pleasures than most occupations.

The satisfactions derived from life and work on farms are partly obtained from the actual labor in the fields and on the livestock, and partly from the management of the farm. On a family farm, this management is not a function of the head of the family alone — it is a cooperative endeavor in which the whole family takes part, at the breakfast table and in the family councils. The whole family thus shares in the satisfaction of seeing the farm business grow and develop.

FARMSTEADS

The center of activity on the farm is the farmstead. What makes up a farmstead — the farm dwelling, the barns and granaries, the pens and yards for the livestock if there are any, and the garden if there is one — is much the same everywhere. But great variety is possible in the way in which these components are put together. There are as many styles of farmsteads as there are of architecture. They developed, each in its own way, out of the reaction of people to their particular environments. Usually there is a reason for the particular style of farmstead. It will not be possible in this chapter to go farther than to introduce the subject.

The conventional farmstead in the northern half of the United States east of the Great Plains follows one of two patterns: the first, with the barns and outbuildings in the rear of the farmhouse, and the yards

behind the buildings; the second, with the dwelling and barns paralleling the road. The garden and orchard are usually placed next to the house. The direction of the road is likely to determine the choice between these two patterns. If the farmer has livestock, he usually wants his yards on the south side of the barns in order to protect the cattle from the north and west winds. The slope of the land may also be a factor. This is well illustrated by the farmsteads developed by the Swiss farmers in Green County in southern Wisconsin. What was sought in this case was a site for the barn consisting of a sidehill facing the south. A roof built out over the yard furnishes protection for the cattle from the storms. The barn — a large one — stores as much of the winter feed as possible. No doubt this type of farmstead has European antecedents. Another type of farmstead in this country is illustrated by Figure 4; and farmsteads in Denmark and Quebec by Chart 5 and Figure 3. The Maine and Quebec farmsteads are adaptations to the deep snows and long cold winters.

VARIANT TYPES OF FAMILY FARMS

In this section, a brief description will be introduced of types of units in agriculture that do not fit exactly under our description of the family farm. Most of these fall under the fourth division in the 1945 census classification, called small-scale farms.

SMALLHOLDINGS The term "smallholding" has not been used much in the United States, but should be used more. It is, in fact, a European term, but still of very good ancestry. The British use it to describe the holdings which they create by buying an estate, laying it out into small tracts, and erecting farm buildings upon these. They sell these to families on liberal long-term credit. The tracts range from under 10 acres to around 40, depending upon the type of agriculture: if poultry or truck or fruit farming, from 2 to 10 acres; if diversified crop-and-livestock farming, from 20 to 40 acres. In all cases, the labor is mainly by hand, with the assistance of one or two horses or oxen or cows. The essential character of a smallholding is a rather high ratio of labor to land accompanied by a relatively small income.[5] The term therefore fits perfectly a very large number of small one-mule or even two-mule cotton and tobacco farms in the South, and a fair number of small poultry and truck farms in the North. It was for this reason that the authors introduced the term in Table 2.

[5] Of course, if a system of farming of a highly intensive sort is developed on a small tract, as may be the case with poultry farming or production under glass, such farms are no longer smallholdings. They have become sizable farms because of capital and volume of output.

The smallholdings program was originated, however, in Denmark and other countries in western Europe. Its object was to convert tenant and especially farm laborer families into owner families. These families did not have resources enough to become owners of full-sized family farms. Their governments believed it was better to have them owners of small tracts of land than hired laborers on large estates. Around the turn of the century, the smallholdings movement had a notable development in parts of Germany. Then following the First World War it swept over the Balkans clear to Hungary and Rumania. It was the first development in Russia following the Revolution.

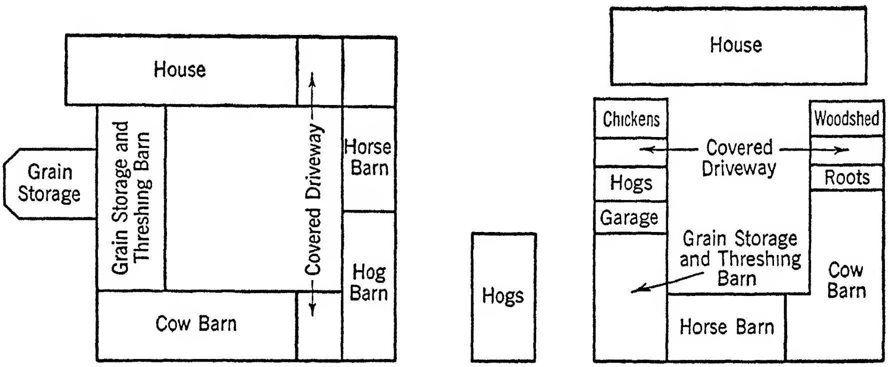

CHART 5. Old farmsteads in Denmark, built in 1740 and 1850. The central yard in Danish farmsteads is usually paved with cobblestones. (Supplied by Dr. Einar Jensen, now Agricultural Attaché of the United States at Berne, Switzerland.)

It will be apparent that smallholdings are a type of family farm — a small-scale type with a high ratio of labor to land. One should not, however, use the term "family farm" when one means "smallholding." The small-scale farms that some are urging upon this country should be called smallholdings and not family farms. The Bankhead-Jones tenant-purchase program developed in this country since 1938 is not a smallholdings program. Its essential feature is that the units be large enough so that labor can be used economically and so that the family can earn a sufficient income to pay off the heavy debt which such a farm carries. Early in its program, the Farm Security Administration made a good many rehabilitation loans to one-mule cotton farmers. Its present policy is to restrict even these loans to larger units.

The units that were created under the Subsistence Homestead Act in 1933 were also mostly smallholdings; likewise, the holdings upon which servicemen were placed in this country after the last war.

Europe, of course, had a very large number of smallholdings before the governments took a hand in creating more. Most European farms falling between two and ten hectares are essentially smallholdings. These make up over half of all the farms larger than two hectares in Austria and most adjoining territory. Yet in countries like Denmark and Sweden it is easy to distinguish between the regular family-size farms and the smallholdings that have been set down among them.

Growing or buying feed for a horse or team has always been a major problem on smallholdings. The smallholders of eastern Europe have commonly solved it by using cows as draft animals. The small types of tractor now being introduced, powerful and versatile enough to plow and do all the work on tracts of smallholding size, are likely to have an important effect on the economy of smallholdings in a country such as the United States. Thus far the smallholding has fitted poorly into most sections outside of the South, and it survives in the South only because of the high ratio of farming population to land resources.

PART-TIME FARMS When the census enumerator asks a part-time farmer his principal occupation, he usually names something other than farming. In 1939, there were 760,000 who reported 150 days or more of labor off the farm during the preceding year; 184,000 more who reported 100 to 150 days of such work, and 260,000 more who reported 50 to 100 days. However, one cannot judge the scope of the farm operations wholly by the days of labor off the farm by the head of the family; frequently other members of the family carry on a considerable program of farming.

Part-time farms need to be located near to other employments, which ordinarily means near to cities, but can mean near to mines, lumber camps, dams, and other engineering works. In the nineteenth century, large numbers of part-time farmers lived near the factories scattered widely over the Northeast to take advantage of the water power on the numerous streams. When the factories moved to the larger cities on the railroads and the seashore, these part-time farms disappeared, but in due time others took their places around the new factory sites, the men driving to work in automobiles. Early in the nineteenth century, the town of Sutton, eighteen miles out of Worcester, Massachusetts, was more populous than Worcester, which now has 200,000 inhabitants. Sutton then had a few small workshops where some part-time farmers worked, and 200 farms. Today it has only a score or so of real farms, and the farm dwellings are occupied mostly by men who drive daily to work in Worcester and other factory towns. Some of them are carrying on

enough farming to be called part-time farmers; most of them not. Much of the land has reverted to timber.

With the growth of manufacturing in the South, many small-holdings formerly used to grow cotton and other crops have become part-time farms. One will also find groups of them around some of the cities of Kentucky, growing each year an acre or two of tobacco. Part-time farming is more likely to develop among groups of foreign ancestry. The Finns are likely to practice a good deal of part-time farming on lands near mine locations. Mr. Henry Ford has been undertaking to develop part-time farming among his workers at Dearborn, Michigan.

The proportion of part-time farmers can be expected to be much higher in the densely populated countries of Europe than in the United States. The 1930 World Census of Agriculture showed 36 per cent of the farm proprietors of Czechoslovakia reporting farming only as a subsidiary occupation; 31 per cent of those of The Netherlands; and 39 per cent of those of Norway. In Massachusetts in 1940, around 30 per cent of the farm operators had other occupations employing their services 150 days or over; in Ohio, 18 per cent; in Iowa, 5 per cent.

HOMECRAFT FARMS These are farms on which home manufacturing is combined with farming, and hence really a special type of part-time farm. They are much more common in Europe than in the United States, and still more common in Asia than in Europe. Not long since, a large portion of the cloth used by the general population of the Orient was spun and woven in homes — and this meant in farm homes, since the population of these regions is much more largely rural than urban. Modern factories can make cloth with much less labor than these rural households, and even after allowing for the higher costs of living and wages in the cities, can sell their output at prices that make conditions very hard for the rural households. It was for this reason that Gandhi campaigned for the return of the spinning wheel. Nevertheless, the shift toward factory production of cloth and other articles of common use has continued. It has gone much farther in Japan than on the continent of Asia.

The homecrafts that persist are those in which hand labor is still needed or is not at much disadvantage. Some of these are products in which the handmade product has a preferred market, like hand-woven woolens and linen and handmade furniture. Also more recently, the wide distribution of electricity in Europe and the United States has made it possible for small rural workshops to use electric motors and small types of machines such as lathes and knitting machines.

So general has been the combination of home manufacturing with farms in Switzerland that until 1930 no attempt was made to obtain a census of farms. "Establishments" were counted instead, and these were classified according to the relative proportions of farm and other employment of labor.

A related type of part-time farm is one that combines the operating of a rural mill for the grinding of corn or wheat, or a distillery (in Europe mainly but not altogether), or a cider press, or a sorghum mill, or a cheese factory, or a sawmill, or a garage or filling station, with farming.[6] The mills may operate only at certain seasons, or like the country mills in the South, on certain days a week, so that considerable farming can be done on the side.

RESIDENTIAL FARMS This term has come into use in the United States to describe establishments maintained in rural districts mainly for purposes of residence rather than for production. They can be nothing more than part-time farms if very little work is done on the farm. In his study of types of farming in Connecticut, I. G. Davis classified farms as residential if less than fifty man-days of work were done upon them in a year. The residential farms that most nearly fit the definition are those whose families have a source of income from inherited wealth, accumulated savings, servicemen's pensions, teachers' pensions, social security payments, and the like, and do not need to work full time for a living. Summer homes and country estates are one type of residential farm — an important one in the Eastern states. We can expect to see a large increase in the number of such residential farms in this country in the next few decades because of the increase in pension receivers.

WORKINGMEN'S ALLOTMENTS AND CITY GARDENS In the outskirts of the cities of Great Britain and many sections of Europe, many fields are laid out in small garden patches that ordinarily are referred to as *workingmen's allotments*. The workers ordinarily lease these from the municipality. A common means of transportation to and from them is by bicycle. The allotment program developed rapidly in the period of unemployment following the First World War, in the depression of the early thirties, and again during the Second World War. There had been no development of similar magnitude in the United States until the Victory Garden movement during the Second World War. How many of the wartime gardens will be continued will depend upon the encouragement given by the cities, upon conditions of employment, and upon the length of the work week. Much more of the urban gardening is of the

[6] The United States Census does not collect data on rural distilleries.

backyard type in the United States than in Europe, where most of the city lots are too small for gardens. Surrounding these cities, however, are suburban areas where not only gardening, but often poultry and rabbit farming, are practiced on tracts of a fraction of an hectare.

FURTHER READING

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F. L. Tomlinson, "The Cultivation of Allotments in England and Wales during the War," International Institute of Agriculture, *International Review of Agricultural Economics*, April–June, pp. 162–210, 1923.

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EXERCISES

1. Make up a balance sheet for some common type and size of farm in your community at prevailing levels of prices and values, as of December 31 of the year past.
2. Make up an operating statement for the same farm for the last operating year.
3. List as many farms and other establishments as you can in your home area and classify them as nearly as you can as to whether or not they are farms, and as to which class they would have fallen into.
   (a) In 1929. (b) In 1939. (c) In 1945. (Table 2)
4. What are the principal occupations of the part-time farmers in your home area? Are any of them homecraft farms?
5. Make a list of a half dozen or so of residential farms in your community.

CHAPTER IV

The Farmers

THE INTENT OF THIS CHAPTER IS TO PRESENT IN BRIEF SPACE AS GOOD a description as possible of the people who do our farming — of the farm operators, both the owners and tenants, and of the farm laborers, both those working at home and those hired — and to consider the parts which they play in the economy of agriculture. The facts presented relate largely to the United States.

The American farmer is first of all a farm worker. He does most of the work on his farm himself. We have already noted that an average farm in the United States in 1939 used the labor of one operator, except for the time when he was engaged in off-the-farm work, plus that of 0.4 units of family labor, plus that of 0.5 units of hired labor. His labor force runs a little higher in the summer months — a fifth higher at the peaks in July and October according to Chart 6, but as much lower in the winter months. The average farm labor runs considerably higher in western Europe: Germany, 3.1 workers; Denmark, 3.0; and Holland, 3.5. Bulgaria and Poland in eastern Europe average 3 or 4 workers per farm. In most of these countries, the averages represent high employment on large estates at one extreme, a large number of smallholdings at the other, and a goodly number of family-size farms in between. Countries such as France, Norway, and Sweden, with few large estates, average around 2 workers per farm. The many part-time farms and smallholdings in countries like Italy, Czechoslovakia, and Hungary bring down the average to 1.5 to 1.7 workers per farm.[1]

LABOR VERSUS MANAGEMENT VERSUS ENTREPRENEURSHIP

Although labor and management on most of the farms are performed by the same person, the functions can be distinguished. Labor is working directly with materials, tools, machines, and livestock; management is

[1] D. Warriner, *Economics of Peasant Farming* (Oxford, England, Oxford Univ. Press, 1939), p. 3.

directing the work of those who handle the materials, tools, machines, and livestock. Management involves planning the business, and the work to be done from day to day, and directing the performance of it. One is handling materials, tools, etc., and the other is handling men.

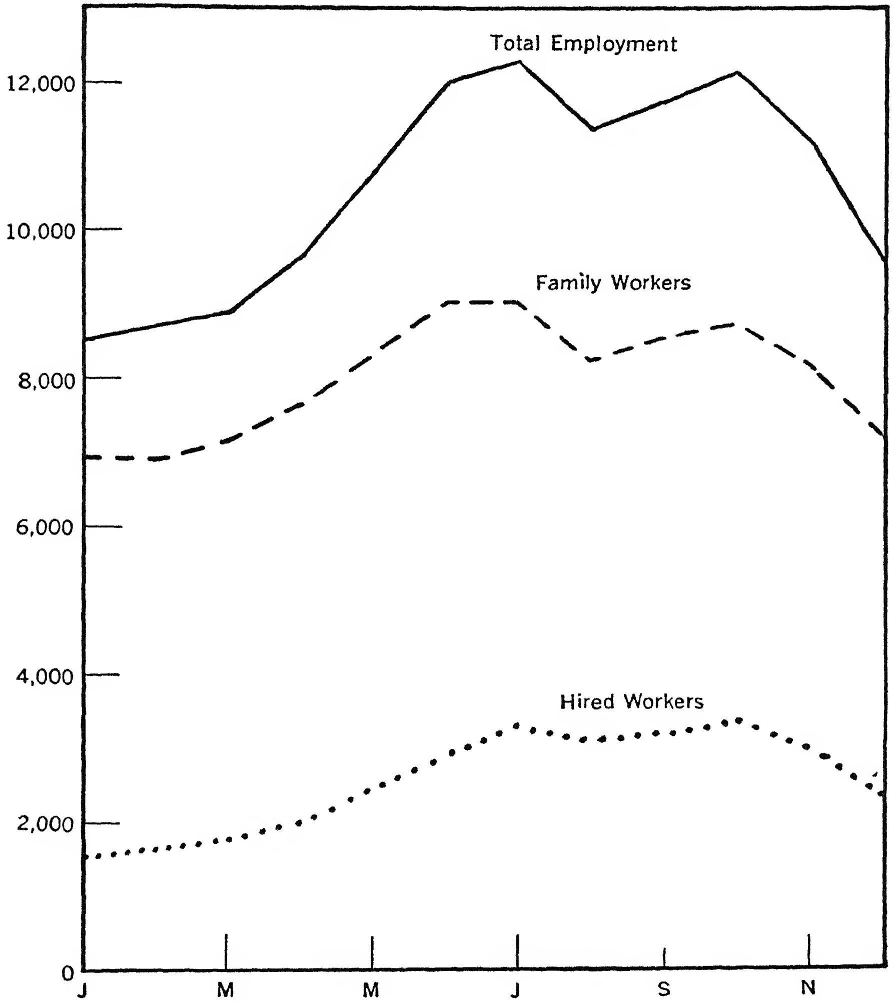

CHART 6. Seasonal variations in thousands in the farm labor force of the United States in 1940, hired, family, and operator labor separately and combined. The summer increase consists more of family than of hired labor.

On a strictly one-man farm, however, the operator plans his business at odd times, and directs his own labor as he goes about doing it. He thus shifts from one function to the other, or carries on both at the same time. If the farm operator works with a few helpers, he directs their

work as well as his own as they go along. Because his business is larger, he gives more thought to its management, and at times he may need to take whole days out for it. Buying and selling also require a good deal of attention. Only when the farm becomes large enough to employ from three or four to fifteen or twenty men, depending upon the type of agriculture, does the farm operator devote all of his time to management.

Most farmers in this and other countries, therefore, cannot be called either farm managers or farm laborers. If called either, the implication is that they confine their efforts to that function. In this textbook, the term *farm operator*, or just plain *farmer*, is therefore used. A farm manager is to be understood as one who devotes most of his time to management; and a farm laborer as one who does very little managing.

To complete the description of workers in agriculture, we must bring in the third type of worker in agriculture, the *enterpriser*, or to use the more familiar French term, the *entrepreneur*. Nearly always in agriculture, of course, he is the same person as the manager. The entrepreneur differs from a hired manager in that he is responsible to no one but himself in the making of decisions. He sets up the business, takes the risks, and decides whether it will continue or stop. In large businesses, the entrepreneur may do very little managing in the sense of directing the handling of materials, machines, and men, but may employ hired managers for this purpose.

The typical owner-operator is therefore a combination of laborer, manager, and entrepreneur. The cash tenant performs all of these functions also but divides the entrepreneurship with the landlord. The share tenant is somewhat less of an entrepreneur than the cash tenant. The management is mostly performed by the tenant, especially on cash-rented farms. The Southern cropper has still less entrepreneurial responsibility, and his managerial function is also reduced greatly. Consequently, farm labor is usually managed by some kind of an entrepreneur, by a person who has probably staked his whole fortune on the outcome of the enterprise.

It follows from the foregoing that on the usual farm in this country or elsewhere, a farm operator's labor-management problems are limited mainly to directing his own efforts and supervising the work of other members of his family. Many of them, however, must hire and manage a certain amount of casual labor, largely for crop harvest, and fewer of them also a year-round helper or two. Only on the large estates of England and of other parts of Europe, and on the larger farms and plantations of this country, especially in California and the South, do the operators spend much of their time supervising the work of others.

24 per cent craftsmen and foremen. The census has a classification called *operatives* in which it puts 37 per cent of the factory workers, 10 per cent of the construction workers, and less than 2 per cent of the farm workers.

Although skills in doing the day-to-day round of field and chore operations on a farm can be separated from the managerial skills, the distinction is not very real on the usual family farm. The line between the kind of directing of their own labor which farm laborers do, and that done by the farm operators directing their own labor, is indeed difficult to draw. One can, therefore, properly contrast the role in society of the so-called skilled worker in urban occupations and that of the ordinary farm operator or hired man. The skilled workman has only a limited number of special skills to perfect, and if he follows a few simple rules of good conduct such as honesty, courteous manners, and reasonable industry, his success as a workman is assured. Unless he becomes the victim of an accident, of ill health, or of unemployment, he can confidently carry through the financial obligations of buying and paying for a modest home. The same description applies almost equally well to a white-collar or an unskilled worker. The farm worker, in contrast, assumes responsibility for the success of a continuous round of activities. If the seedbed is disked when it is too wet, the physical condition of the soil may be ruined for the balance of the season. If the soil becomes too dry, it may be difficult to plow. If the seed is planted too deep, fungi may destroy the plants before they become established; if planted too shallow, the seed may not get sufficient soil moisture to germinate. Different seeds require different seeding depths. Small grain cut too early does not produce a full crop, yet if it becomes overripe it shells out in the field or may be blown down by a storm. Improper shocking of the grain may result in excessive storm damage. The successful farmer must understand enough about practical soil chemistry and physics and plant genetics to plan and carry out crop rotations, and fertilizer and soil-conservation programs.

Livestock farming when carried on is usually in addition to crop production. Farmers throughout northern United States and in large sections of the South to be successful must be skilled both in crop production and in animal husbandry. Rudimentary knowledge of animal physiology, of feeds and feeding, and of disease control is essential for successful livestock management.

With the extension of electricity to over half of our farms, and with the shift to tractor power on most commercial farms, the successful farm worker also must be something of an engineer. While the villages and towns are usually well supplied with repair shops, unless the modern

farmer has the ability to keep his machinery in adjustment and can perform the minor repairs, his power and machinery repair costs will be excessive.

Farmers are only a cross section of humanity. They possess the abilities to develop the different manual and mental skills and business judgment in about the same proportions as other groups of people. The ability to perform manual labor is rarely at a premium in agriculture. Even mechanical skills appear to be much more widely distributed than ability to judge and to plan.In a special study of the human factors associated with financial success in farming in Minnesota,[2] the six following factors were listed as most important by a group of seventy-two successful farmers:

Farm experience	1st
Wife's cooperation	2nd
Ambition to succeed	3rd
Liking for farm work	4th
Getting work done on time	5th
Hard work	6th

Other factors listed as important were buying and selling ability, and ability to handle labor. The study showed a close relation between knowledge of technical agriculture and the size of the annual net incomes. Farmers who scored high in the mental alertness and ambition tests (for the most part the same ones who possessed the most technical information) had net incomes much higher than those who scored lower in these respects.

Some were operating farms because they were born into agriculture and had never found it possible to get into an occupation more suited to their personal interests. Even among those who expressed a definite preference for farming, many had enterprises on their farms which they disliked. A few, even though they did not like dairying, had dairy herds on their farms because they thought it the most profitable way to market their roughage and to use family labor. Probably more farmers dislike poultry than any other enterprise, although most farms have at least a few chickens. Hogs are kept on many farms for economic reasons, even though the operator may dislike hogs and the work of caring for them.

THE FARM WORKING FORCE

Let us now proceed to obtain a clearer picture of those who do the work on farms. Chart 7 shows the age differences of the three principal groups in the United States. Such a chart would look very different

[2] Walter W. Wilcox, Andrew Boss, and George Pond, *Relations of Variations in the Human Factor to Financial Returns in Farming*, Minnesota Bull. 288, 1932.

for the European countries which have large permanent farm labor classes. The numbers of unpaid family workers are largest in the 16-to-19-year age-group, and fall away rapidly from that point on. The boys are serving their apprenticeship in these years on the home farms. Those older than 25 years are mostly women. The numbers of hired workers reach their peak in the 20-to-25-year age-group. After that, in this country, the hired workers either become tenants or leave agriculture in large numbers. The majority of those above 40 years are migrants

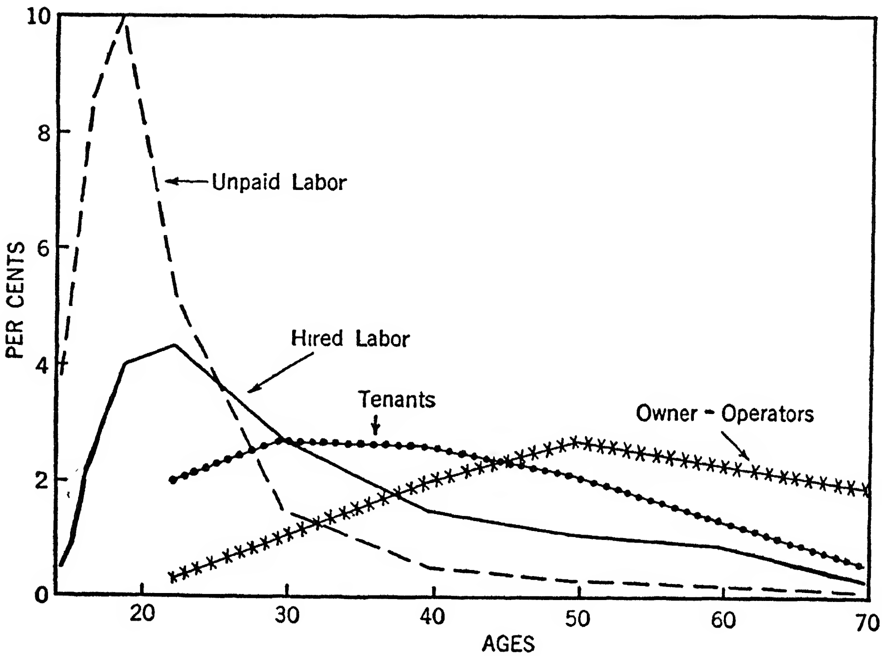

CHART 7. Percentages of unpaid family workers, farm wage workers, and farm owner-operators and tenants in different age-groups, 1939. Both sexes.

or Southern cotton hands. The average age for full owner-operators centers around 53 years, and for tenants and croppers, 41.5 years. Of owner-operators and tenants combined, 46 per cent of the Negroes are under 45 and only 39 per cent of the whites.

The best way to bring out the major difference between the states in the age of farm operators is to ask what per cent of them are 55 years old and over. The range is from 25 per cent in Mississippi, and upwards to 30 per cent in other Southern states; 28 to 35 per cent in the Plains and Mountain states of the West; 30 to 41 per cent in the Corn Belt; and 42 to 49 per cent in the Northeast, with most of the New England

states running 47, 48, and 49 per cent. The California figure is 42 per cent, and the Florida figure, 38 per cent.

Chart 8 shows that a much larger proportion of the hired labor force on farms is in the early age-groups than is that of the other major occupational groupings. The age-groups in which farm laborers are less likely to be found are those between 30 and 50. These are the periods of life when farm workers are likely to be farm operators, and if not, to migrate to the cities for other occupations.

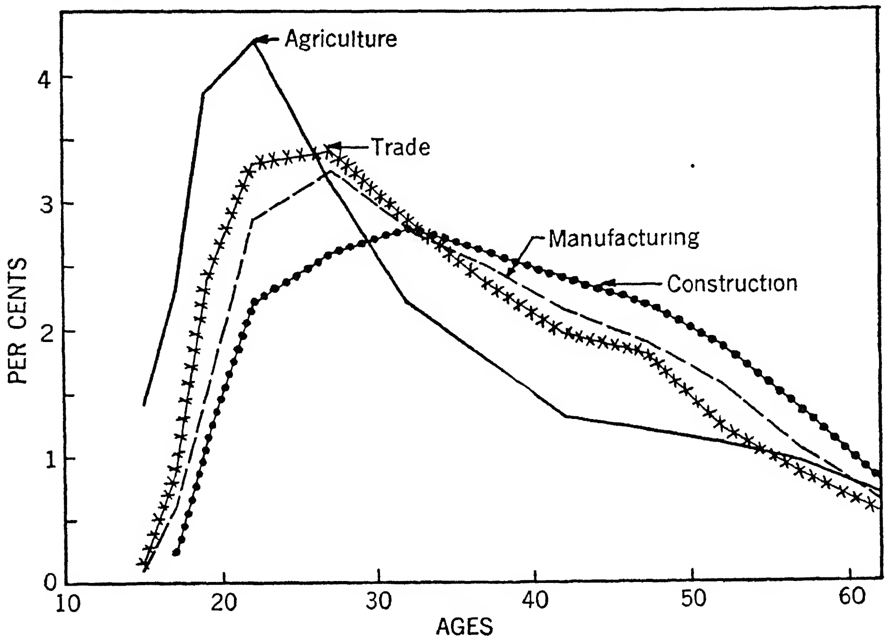

CHART 8. Percentage of hired labor force in different age-groups, agriculture compared with trade, manufacturing, and construction, males, March, 1940.

The data presented in these charts leave out entirely one important phase of family farming — the contribution to it of the farmer's wife. Without her, it is impossible to realize the extent to which farming is in the fullest sense of the term a family enterprise. The farmer's wife, because of the isolated location of the farmstead, prepares the meals for any extra laborers, and usually furnishes both room and board for any unmarried employees. Except for work on the cotton and tobacco farms in the South, in most other sections of this country, the wife's outdoor contribution to the farming enterprise is limited to the care of a small flock of poultry, and of the garden. Even here she has the cooperation and help of her husband and children — usually the heavier

work on both of these enterprises is performed by one of the men on the place.

In Europe, however, women are more active partners in all of the farming activities. In Holland and Germany especially, girls are often hired for work in the farm dairies. Women do a large amount of the work in caring for the dairy herds. Travelers and writers also comment especially on the heavy work performed by the farm women of France. Arthur Young, after visiting France in the latter half of the eighteenth century, wrote that no contrast was more striking between rural England and rural France than the work performed by women. Commenting on a woman's bent figure and face furrowed by toil until she looked sixty years old while only twenty-eight, he ventured the opinion that the women of France worked harder than the men. Yates, after quoting these observations of Arthur Young, wrote in 1940 that, "There has been a steady improvement since the time when Arthur Young wrote, yet broadly, his description remains true today. The women work harder than those in most other western countries, and they work harder than their menfolk." [3] Farm women also do a great deal of the farm work on the smallholdings of eastern Europe and in Asiatic countries.

In most cases, the woman's contribution to the farm enterprise is more in the nature of a skilled workman than as a full partner in planning and supervising the farming operations. A few farms are operated by widows. Usually, such a farm is rented out, unless one of the boys in the family is old enough to take a leading part in planning the day-to-day operations and in carrying on the work of the farm. Very few farms are operated by women without a male relative on the place to take charge of the farming operations.

The child labor laws of this country do not apply to children raised on farms who work with their parents. In earlier years when many farm children did not go beyond the eighth grade in school, and when the school year was limited to seven or eight months, a large family of children on the farm was an economic asset. Usually sufficient land could be obtained to keep them fully employed. Today, formal school training takes up a larger part of the children's time. But one of the great advantages of farming from a family-living standpoint is still the training in self-reliance and manual skills which children develop while assisting their parents with the farm work.

The historical changes that have taken place in the average farm labor force are indicated clearly by Chart 9. The average farm in 1870

[3] P. L. Yates, *Food Production in Western Europe*, pp. 284–285.

employed 1.20 workers exclusive of the farm operator. The decline since has been due mainly to mechanization, to increasing school attendance, and to less work by farm women. In 1910, over 36 per cent of the farm population was reported as gainfully employed. By 1940, this percentage had declined to 30, in spite of smaller families. In 1910, over 9 per cent of the farm labor force consisted of children under sixteen; in 1930, less than 5 per cent. The ratio of females to males in the farm labor force was 1 to 11 in 1930 as compared with 1 to 6 in 1910.[4] The figure of 30 per cent of the farm population at work on farms may be compared with 40 for the national population in the national labor force. A larger proportion of the nonfarm population is of working age.

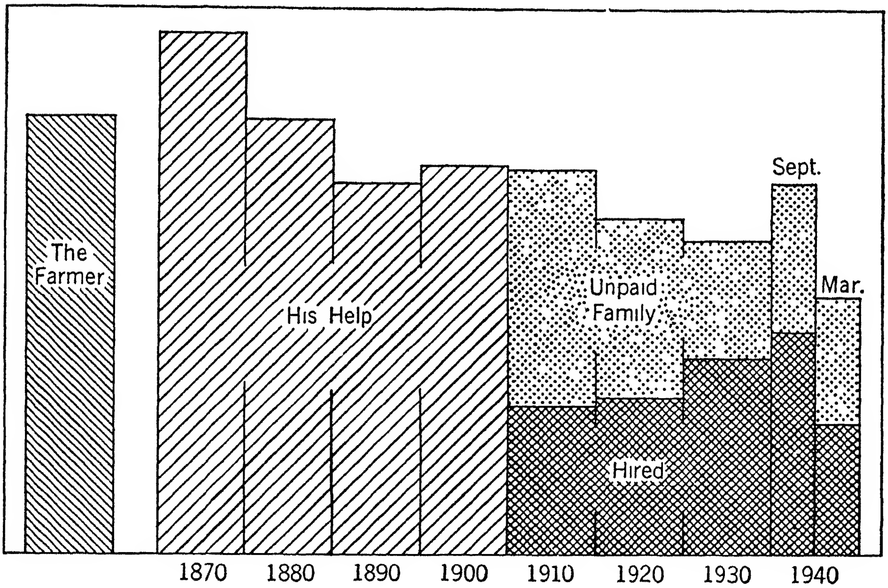

CHART 9. Average working force per farm in the United States, 1870 to 1940. The census data do not separate unpaid and hired labor before 1910.

HIRED LABOR

Many things about the agricultural working force besides its size have changed in the past fifty years. The farm operator in no small number of cases has another job to which he is giving his major attention. He may even employ a manager, foreman, or herdsman whom he directs night and morning, or on week-end visits. The farm boys and girls are more likely to seek jobs elsewhere when they finish school.

[4] The 1940 census figures on women and children employed in agriculture are incomplete.

Probably, however, the hired labor has changed most of all. Fifty years ago, the "hired man" was one of the most typical figures on the American farm. He was frequently the son of a near-by farmer, and as such was the social and intellectual equal of the members of his employer's family. If he was of some other description, perhaps a recent immigrant, or "newcomer," or the son of an immigrant family from another area, he could by industry and ability soon establish his own reputation and his place in farm circles. He was readily accepted as a member of the farm group. In the East and Midwest he was usually an unmarried man. He ate at his employer's table, lived under the same roof, and shared the plans, work, and joys and sorrows of the household. Often he was able to save enough in five or ten years to get started as a tenant, and eventually to become an owner.

Hired men of this description are not very numerous today. Many native-born farmers' sons have been attracted to other lines of work, and the immigrants no longer come. Opportunities for hired men to become tenants and farmers have worsened as land and farming equipment have become more costly. Most of the regular hired men still live under the same roof with the farm family. All but 10 per cent of the hired agricultural workers in March, 1940, were living on farms, and two thirds of the remainder were living in rural villages. But they are no longer members of the community in the same sense as formerly. They are likely to have automobiles or motorcycles and to seek their companionship in the nearest town or city.[5]

But hired farm labor is highly important only in certain segments of agricultural production. Only 38 per cent of the farms in the United States hired any labor at all in 1940, and the average wage bill on these farms was only $346, equal to eleven months of labor at the prevailing wages. In March, 1940, 72 per cent of the farms hiring labor were employing only one laborer; 15 per cent, two laborers; 7 per cent, from three to nine laborers; and less than 1 per cent, ten or more laborers. But one farm with ten helpers is likely to be as important in production as five or more with one helper. So the question needs also to be asked in another way: How many of the hired laborers were working on farms as one of ten or more? In 1935, the answer was 15 per cent for the country, 32 per cent for the Pacific states, 25 for the Mountain and West South Central states (including Texas and Oklahoma), but only 3 per cent for the West North Central states (Minnesota to Nebraska).

[5] See *Background of the War Farm Labor Problem*, released by the Bureau of Agricultural Economics, 1942, pages 57–58.

Except in the Far West, half to three fourths of the farm hands were working on farms with only one or two farm hands.

MIGRANT LABOR The two other groups of hired farm workers are those who live near-by and help out with picking and other harvesting operations, and the migrants who mostly have no other means of livelihood and move from one area to another. Some of them move across the national boundary from Mexico and back again each year. The number of these has increased with the increase in large-scale specialized vegetable and fruit production. The large users of migrant labor are the fruit and vegetable areas of the Northeast; the vegetable and citrus areas of Florida, Texas, and California; the fruit and sugar-beet areas of the Western and North Central states; the Pacific Northwest potato and fruit areas; the tobacco, potato, and fruit areas of New England; and the cotton areas of the South and Southwest. California presents the problems of migratory labor in their extremest form. Inspectors at the border of California counted 412,000 manual workers entering the state in cars registered from other states between 1935 and 1940. Of this number, 67 per cent were from the Plains states. The largest streams were from Oklahoma and Texas, followed by Arkansas, Minnesota, and the Dakotas. The remainder of the migrants were from the other Pacific states and Arizona and Idaho.

The routes of migrant workers are rather definitely defined and fall in distinct patterns extending along the Atlantic and Pacific seaboards and up the Mississippi Valley. Streams of migrants converge on the sugar-beet, fruit, and truck areas in Florida, Texas, and California and northward. In the potato region of New Jersey, the migrant workers are chiefly single adult Negro males, principally from Florida and Virginia. Those from the deep South usually make two or more moves along the Atlantic coast before they reach New Jersey. The workers in southern New Jersey are chiefly Italians, most of whom come from Philadelphia and vicinity. These move in family or semifamily units, the women and children working along with the men.

In spite of their meanderings, many of these migrant families obtain work for only about half of the year. A sample studied in 1941 averaged 35 weeks for the males in the family and 13 weeks for the females.

THE TENANTS

Chart 7 in this chapter showed the over-all age distribution of the tenants in this country as compared with that of the laborers and owner-

operators. Table 4 gives the data for the tenants in several subgroups. The differences among the regions are slight, and even between whites and Negroes in the South. The tenants are mostly relatively young men. In the North, only 38 per cent of them were over forty-five years old; in the West, only 41 per cent. The comparable figures for Southern whites and Negroes are 36 and 40 per cent.

TABLE 4. PERCENTAGE OF TENANTS IN DIFFERENT AGE-GROUPS, UNITED STATES AND BY REGIONS, 1940 [a]

Age-groups	*United States*	*North*	*West*	*South*	
				Whites	*Negroes*
Under 25 years	8	6	6	9	9
25 to 34 years	27	26	24	28	23
35 to 44 years	26	27	25	24	22
45 to 54 years	21	21	22	19	19
55 to 64 years	13	12	14	12	13
65 years and over	6	5	5	5	8

Source: Census of 1940, Agriculture, Vol. III, p. 377 ff.
[a] Not including from 3 to 8 per cent for the different regions whose age was not reported.

The reduction in percentage in the upper age-groups is, of course, not because the others have all become owners. A certain fraction of them have died before reaching these age brackets. Others have given up farming and gone into other occupations. Perhaps they have been unable to rent another good farm because of their age, their equipment, or their reputation. The final effect, anyway, is that we do not have any large permanent tenant class in the United States.

The idea is prevalent in this country that tenants are climbing the agricultural ladder more and more slowly because of the increasing cost of equipping a farm with machinery and livestock and the rising prices of land. If this were true, our tenant class would be made up of more and more old men. Table 5 throws a good deal of light on this subject. In 1940, out of every 100 farmers under 25 years of age, 79 were tenants, and 64 out of 100 in the 25-to-34-year age-groups. Most of our young farmers are therefore now starting in as tenants. They may get some help from their parents, but it is not enough to enable them to buy a farm. In the 35-to-44-year age-group, however, less than half of them are left as tenants, and above 55, only a fourth of them. Back in 1890, in contrast, only 67 out of every hundred had to start in as tenants. The increase in the number of tenants has thus been greatest in the

ages 25 to 44. Our tenants on the whole are therefore getting younger rather than older; it is in the younger years that the increase is the most.

TABLE 5. CHANGES BY AGE-GROUPS IN PROPORTIONS OF FARMERS WHO WERE TENANTS, 1890 TO 1940

Age-groups	*Number of Tenants per 100 Farmers*			
	1890	1910	1920	1940
Under 25 years	67	76	76	79
25 to 34 years	50	55	56	64
35 to 44 years	36	37	40	46
45 to 54 years	28[a]	27	30	33
55 to 64 years	20[a]	21	21	25
65 years and over	15[a]	15	16	16

Source: Developed from Table 32 in *Farm Tenancy in the United States*, Census Monograph IV, 1920.
[a] Those reported for "55 years and over" in 1890 were distributed in the same proportion as reported for 1900.

The essential features of the change are shown even more clearly in Chart 10. Of the "class of 1870" beginning farmers (25 years old or younger), only 47 in 100 were tenants; of the class of 1910, the 76 given in Table 5. But the rate of graduation into ownership, or transfer out of agriculture, has been enough faster so that at 50 years of age, only 30 of the class of 1910 were still tenants, almost the same as for the class of 1870; and if the present rate continues, there will be fewer tenants at 60 years of age than for the class of 1870. The class of 1920 has had a still sharper decline in tenancy thus far.

These data, let it be kept clearly in mind, indicate a definite increase in tenancy in the United States since before 1900. Many more farm operators are tenants at nearly all ages than earlier. The point emphasized by Table 5 and Chart 10 is that the increase is more in the younger than in the older age-groups; and in consequence there has been no further development of a permanent tenant class in this country. If all the facts were available, however, they would probably show that this has resulted from an increase in the number of tenants who give up in their efforts to climb from tenancy to ownership and in many cases quit farming altogether. Since 1920, also, a good many tenants have become laborers again, especially in the South. Also in the South, apparently many croppers become wage hands in their advanced years.

This country has never fully recovered from the shock which it received when the first census of tenancy in 1880 revealed that 26 per cent of its farms were being operated by renters. The people of this country had been thinking of their farmers as a class almost wholly of freeholders. Why not, with so much "free" land, and liberal homestead entry laws? By 1900, the percentage had risen to 35, and by 1920 to 43.

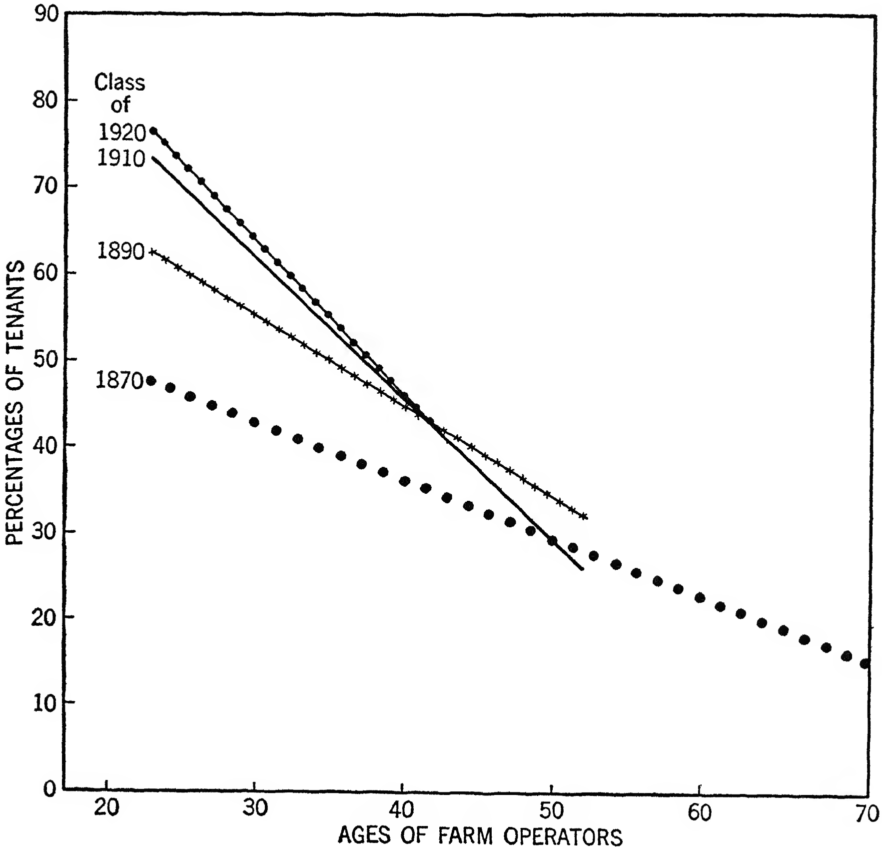

CHART 10. Decrease with age in the percentage of farmers who are tenants, for groups becoming farm operators in 1870, 1890, 1910, and 1920.

The report of the President's Committee on Tenancy called attention to the fact that the number of tenants reported by the census had increased 200,000 in the five years from 1930 to 1935. That was at the rate of 40,000 a year.[6] The 1940 census, however, reported 500,000 fewer tenants than in 1935, and 300,000 fewer than in 1930. The percentage of rented farms had fallen off from 42 to 39. The big increase reported

[6] *Farm Tenancy*, Report of the President's Committee, Washington, D. C., 1937.

in 1930–1935, it then became apparent, was a false alarm, caused by the manner of taking the census. On the other hand, the decrease in 1935–1940 is also deceptive. It mostly resulted from a shift of croppers to farm laborers, and hence represented little change in tenure status. If the croppers are excluded, the percentages of farms rented in 1920, 1930, and 1940 were 29.4, 30.0, and 29.9 respectively. Hence, we can reasonably conclude that tenancy has for the time being come to a standstill so far as the national average is concerned.

Another important subtraction also needs to be made. Outside of the South, many of the tenants are close relatives of the landlords — sons, sons-in-law, grandsons, etc. Renting in this case is merely a device for passing the farm from one generation to the next. The proceeds are divided between landlord and tenant in the usual way, it is true, but little else is on the same basis as in the usual landlord-tenant partnership. The 1930 census asked the following question, "Do you rent this farm from your own or your wife's parent, grandparent, brother, or sister?" The range of affirmative answers was from 10 per cent in Mississippi to 39 per cent in Wisconsin; from 15 per cent for the South as a whole to 30 per cent for the North as a whole.

If these farms and the cropper farms are both removed from the category of rented farms, the percentage of tenancy in the United States as a whole in 1930 would have been around 22 in place of 42, and in the South 23 in place of 56. These last percentages represent the solid central core of tenancy in this country. Thus, it can be said that scarcely one farm in four in the United States is being farmed by a person fully a tenant, either in the South or the North.

THE LANDLORDS

Landlords, in contrast to the tenants, are old men and women. At least, when the last survey of the landlords was made in 1920, their average age was around 60 years in the North and between 50 and 55 in the South.[7] About 30 per cent were retired farmers who had retired at an average age of 54 years. Another 30 per cent were operators of other farms. The remainder were business or professional men, or women who mainly reported their occupation as housekeeping. No doubt these women had come to own their farms in many cases by surviving their husbands. The landlords had purchased their farms in

[7] The census collects no data on landlords. The changes since 1920 have not been large. They include primarily more holding of the land by insurance companies and creditors in recent years, and fewer landlords who are retired farmers.

four cases out of five, and inherited them in most other cases. In the North Central states, however, 7 per cent had homesteaded on the farms which they were leasing to another operator in 1920. Thus in one lifetime, these farms had passed from free land to rented land.

More of the landlords are farmers in the South than in the North, 54 per cent as compared with 20 per cent. The Southern landlord is often a farmer who works part of his land with hired labor and part of it with croppers. The Northern farmer-landlords are commonly well-to-do farmers who own an additional farm or two. Conversely, more Northern than Southern landlords are retired farmers.

In the United States as a whole, only 8 per cent of the landlords were absentees living in another state or county from the farm rented; but in the territory from the Dakotas to Oklahoma, a fourth of the rented farms were absentee-owned. The Corn Belt has a little more than the average of absenteeism, and the South much less.

Important from a management standpoint is also the matter of the number of farms looked after by one landlord. For the United States as a whole, 48 per cent of the rented farms were held by landlords holding one farm, 38 per cent by landlords holding three or more, 19 per cent by landlords owning ten or more, and 13 per cent by landlords owning twenty or more. Most of the landlords owning ten or more farms, however, were in the South, the Mississippi Delta having the highest percentage of any region studied, 72 per cent. In most of the North, from 80 to 90 per cent of the farms were held by landlords holding only one farm.

TENANCY BY REGIONS

To say, for a country as diversified as the United States, that 39 per cent of the farms, if we consider croppers as tenants, were rented in 1940, is not very informative; nor to add that another 10 per cent of the farms consisted partly of rented land, so that 44 per cent of the land in the United States was under landlord-tenant management. Only 7 per cent of the farms in the New England states are rented, 15 per cent in the Middle Atlantic states, and 18 per cent in the Pacific states, as compared with 53 per cent in the West South Central states, 50 per cent in the East South Central states, and 42 per cent each in the West North Central and South Atlantic. By individual states, Mississippi, at one extreme, has 66 per cent of its farms rented, and other Southern states 59 and 60 per cent. Three of the Great Plains states have 53 or 54 per cent of their farms rented. All the really Southern

states have a larger percentage of farms rented than of rented land, because of the small size of the rented farms, and the Western states have more rented land than farms. Ten of the Western states have more additional-rented lånd than land in rented farms — Arizona, six times as much, New Mexico and Utah nearly three times as much, and Montana twice as much. This is mostly grazing land rented by ranchers. South Dakota leads the nation with 70 per cent of its land rented, and the other grain states follow in order.

If counties are taken as a unit, a still wider range appears. Consider, for example, the counties in Table 5*a* selected as examples in ten states having a high percentage of tenancy, and in six having a low percentage of tenancy.

TABLE 5*a*. PERCENTAGE OF FARMS AND OF LAND RENTED

County and State		Percentage of Farms Rented	Percentage of Land Rented
	HIGHEST		
Le Flore,	Mississippi	94	59
Dallas,	Alabama	83	54
Calhoun,	Georgia	87	62
Marlboro,	South Carolina	79	54
Edgecombe,	North Carolina	78	66
Fort Bend,	Texas	67	57
New Madrid,	Missouri	82	73
McIntosh,	Oklahoma	69	74
Hanson,	South Dakota	69	78
Ford,	Illinois	66	76
	LOWEST		
Sagadahoc,	Me. (Central)	2	4
Hamilton,	N. Y. (Central)	3	3
Ocean,	N. J. (Central)	7	9
Meigs,	Ohio (Eastern)	14	17
Kewaunee,	Wis. (Eastern)	7	10
Clatsop,	Ore. (Western)	11	17

It thus appears that certain parts of the United States are centers of tenancy. The largest concentration occurs in the cotton and tobacco states of the South. The second concentration occurs in the range of states from the Dakotas south to Oklahoma and Texas, and reaching over into southwestern Minnesota and western Iowa. This is the region of wheat and other small grains, and of these combined with corn toward

the East. The third center is the Corn Belt — and only certain parts of the Corn Belt, such as the northern two thirds of Illinois and Iowa, have extreme amounts of tenancy.

THE SOUTH As already indicated, those who know most about how the cropper system actually works in the South commonly hold that the cropper is more nearly a farm laborer than a tenant. The census defines croppers as "share tenants to whom their landlords furnish all of the work animals, or tractor power in lieu of work animals." [8] It discovers which tenants are croppers by asking each of them what the

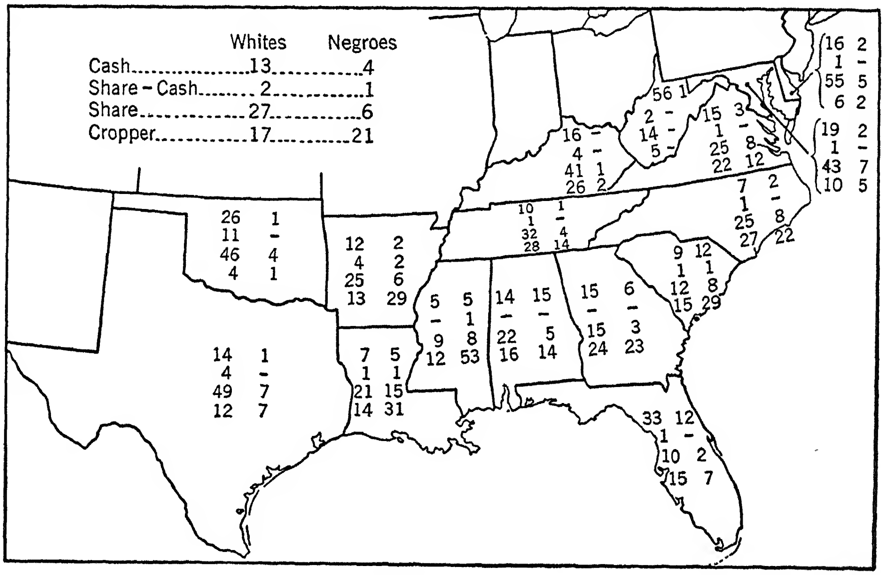

CHART 11. Percentage of tenants who are croppers, cash, share and share-cash tenants, Southern states, whites and Negroes separately, 1940.

landlord furnishes in the way of work animals, tractor power, fertilizer, and seed. Chart 11 shows what percentages of the tenants were classified as croppers, share tenants, cash tenants, and share-cash tenants, for whites and Negroes separately, in 1940. If the large fraction of tenants listed as croppers were classified as laborers, the percentage of farms rented would average only 25 in the South Atlantic states, 27 in the East South Central, and 39 in the West South Central. Croppers are most numerous in the Delta areas on both sides of the Mississippi, and in the Carolinas and Georgia. The seven counties in the "bootheel" of

[8] *Agriculture,* Volume III, 1940, p. 136.

southeastern Missouri have almost as many croppers as Mississippi. Share renting prevails in Texas and Oklahoma.

The obvious reasons for arguing that croppers are laborers and not tenants is that they furnish nothing but labor, virtually all of it their own, and that the landlords make all the major management decisions, do most of the buying and selling except the provisions for the family, and often advance even the money for the latter, and on many plantations direct the work of the croppers from week to week and even from day to day at critical seasons of the year. Especially on the fringes of the cotton-growing region, many of the croppers also work for wages part of the time. Then on the larger plantations, especially in the Delta, much of the land is fitted and the cotton planted by tractor equipment furnished by the central management at a fixed charge per acre, and the croppers work in crews from field to field at cotton picking, each being paid according to what he picks as if he were a piece-rate worker, and in turn being charged at a fixed rate for having his cotton picked.

The census has recognized the foregoing facts to the extent of tabulating croppers separately since 1920. It still insists on calling them tenants, however, because the cropper shares the risk of good and bad crops and high and low prices and therefore "partakes somewhat of the nature of an entrepreneur." The census also points out that the families technically classified as share tenants on many plantations, because they furnish the work animals, really have very little more managerial responsibility than those who do not furnish the work animals, and both are often found side by side on the same plantation.

The number of croppers diminished rapidly from 1925 to 1940, for a combination of reasons, including the increased use of machinery, the shifting of many cropper families to relief work during the Big Depression, and the AAA restrictions on cotton acreage. This trend was reversed during the war when wages rose sharply and wage hands became scarce.

The cropper system persists for the same reasons that brought it into existence. The Negroes became croppers after 1865 because this system was much more like the plantation slavery system than working for daily wages. The Negroes had had no experience in working for a cash income and using it to support their families over the winter. The white croppers originally were sons of white families living on the poorer lands of the South who were forced out of these areas or communities by acute population pressure. They had no resources of their own with which to begin farming. The numbers of both groups keep up because the returns from farming under the cropper system are so low that

only the more industrious and thrifty can accumulate enough property to become full-scale tenants and perhaps owners.

THE GRAIN STATES The principal reasons that renting is dominant in the Grain Belt are: (1) The land lends itself to continued exploitation with simple crop farming. (2) This region is relatively new and much of it has not been farmed long enough to force adoption of less exploitative systems of farming. (3) These simple systems of farming require little supervision from the landlord, and even more important, the crop can be very easily divided between the landlord and the tenant.

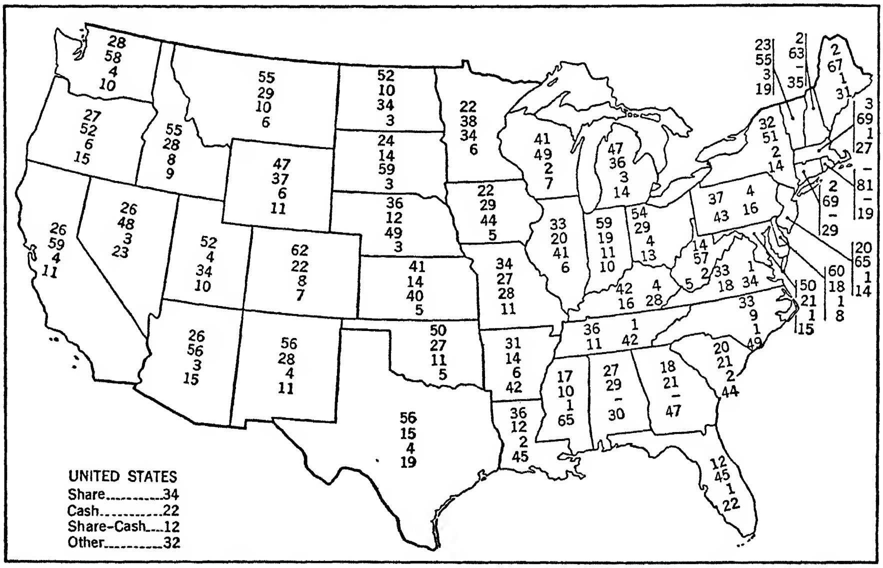

CHART 12. Percentage of rented farms in the United States which are share rented, cash rented, and share-cash rented, 1940.

Chart 12 shows that most of the tenant-operated farms in the Grain Belt are rented on shares or on a share-cash basis. In the latter case, the tenant pays cash for the pasture and other land used to support his livestock. (4) The free homestead system worked out in such a way in this region as to cause a good deal of absentee-ownership. Much of additional-rented land shown in Chart 12 is absentee-owned. (5) The high land values in the eastern part of this region make it difficult for a tenant to buy a farm.

THE CORN BELT Tenancy is relatively high in the Corn Belt for some of the same reasons that it is high in the Grain Belt. A majority of the rented farms are share rented or share-cash rented. Tenancy is more

prevalent in the counties which practice cash-grain farming than in those which feed more of their grain to livestock, and the particular farms which are rented are likely to be those that sell most of their grain for cash. The rented farms may sell either corn for cash, or both corn and small grain or soybeans. The soils in these particular areas are fertile and are still being exploited. The land is high priced and this keeps it in the hands of landlords. The landlords of the Corn Belt are more likely to live in adjoining cities than are those of the Grain Belt.

Illinois and Iowa have more tenancy than Indiana and Ohio, and even the diversified-crop-and-livestock farms are rented in large numbers. But the renting is on a share-cash basis rather than on shares, and much of it, especially in Iowa, is for cash. The tendency is still to rent beef-cattle farms on a cash basis, partly because there is no easy way of dividing the proceeds of beef-cattle farming between the landlord and the tenant.

THE LAKE STATES AND THE NORTHEAST The reasons that fewer farms are rented in the Lake states and the Northeast than in the other regions considered, and that the renting is much more largely on a cash basis, are as follows: (1) The farms are smaller and cheaper, which makes it easier for the tenants to buy them and also more difficult for the tenant family to make a living on them if it must give the landlord a share of the proceeds. A family must live on such a farm and operate it if it is to make a good living on it. (2) The cheaper land is not so fertile naturally, and needs to be farmed with livestock in order to maintain its fertility. This means diversified farming and complicated arrangements for sharing the proceeds between the landlord and the tenant; hence, cash renting if renting at all. (3) The farmers represent a larger admixture of European stocks used to farming on small farms, and to practicing diversified crop-and-livestock farming. These peoples acquired a strong interest in owning their farms in the last century before they migrated, for this was the period in which European estates were being broken up into smallholdings. (4) Mixed systems of farming are prevalent in this region, dairy and poultry and fruit or truck crops frequently being combined on the same farm or in the same community. Only dairy farming has been converted to a successful share-renting basis in this region, and even this only in part of the areas. (5) A large proportion of the farms in this region are operated on a part-time basis.

PACIFIC AND MOUNTAIN STATES Except for much renting of public and private grazing lands in the ranching parts of the Far West, tenancy is low for any one of several reasons, depending upon the area. Nearly

everywhere the relative newness of the farming is an important factor. A large fraction of the farms are irrigated. Reclamation land was sold only to owner-operators in the first instance, and renting has not had time to develop. Wherever grain farming is dominant, however, a good deal of share renting has appeared; for example, in eastern Washington and Oregon, in southern Idaho, and in northern Utah. For reasons discussed in the chapters on cattle and sheep ranching, the ranches of most of these two regions tend to remain on an owner-operated basis. In California, much of the farming requires a good deal of capital and does not lend itself to any form of renting. Owners of orchards do not like to intrust them to tenants. Much of California agriculture is complicated and requires intensive management. California also has a large number of part-time farms near to cities. These same circumstances prevail, but in lesser measure, in parts of Oregon and Washington. In the more diversified farming of the Willamette Valley of Oregon and Central Valley of California, a fifth or more of the farms are rented.

THE OWNER-OPERATORS

The age distribution of the owner-operators of farms in the United States in 1940 was shown in Chart 7 in this chapter. The newer regions tend to have slightly younger farmers, and the static or declining areas slightly older farmers. The part-owner operators averaged 49 years old in 1940, compared with 41.5 years for tenants. Thus, part-ownership is somewhat in the nature of an intermediate stage between tenancy and ownership.

A more important differentiation is between farmers with and without mortgages on their farms. Chart 13 compares the age distribution

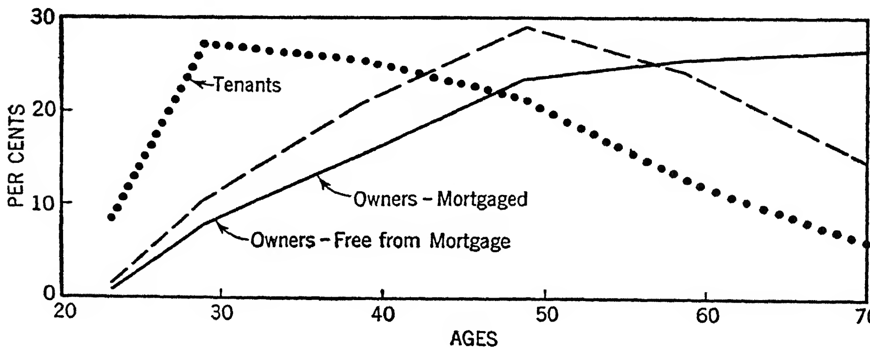

CHART 13. Age distribution of full owner-operators, with and without mortgages separately, compared with that of tenant operators, United States, 1940.

of these two groups with that for tenants, also given in Chart 7. The average age of all full owner-operators with mortgages on their farms in 1940 was 50.6 years, compared with 41.5 for tenant operators. The comparable figure for full owners without mortgages was 54.5. From 50 years on, the percentage of owned farms mortgaged declines, but 15 per cent of the mortgaged farms were owned by persons 65 years old and over. Over half of the farms free of mortgage were owned by persons over 55 years old.

The purpose of Chart 14 is to show that in 1890 only about 32 per cent of the young men starting out as owner-operators at 30 to 35 years of age had mortgages on their farms, and by 1940, this figure had risen to 54 per cent. Fewer had mortgages at these ages in 1940 than in 1930; but not from 50 years on. Except during 1930–1940, the farmers have redeemed their mortgages more rapidly in recent decades than earlier.

A major factor determining mortgage debt is the level of farm real-estate values. The average farm in the United States was valued at $2,910 in 1890; at $5,470 in 1910; at $10,280 in 1920; at $7,610 in 1930; and at $5,520 in 1940. Farm real-estate values were at the First World War

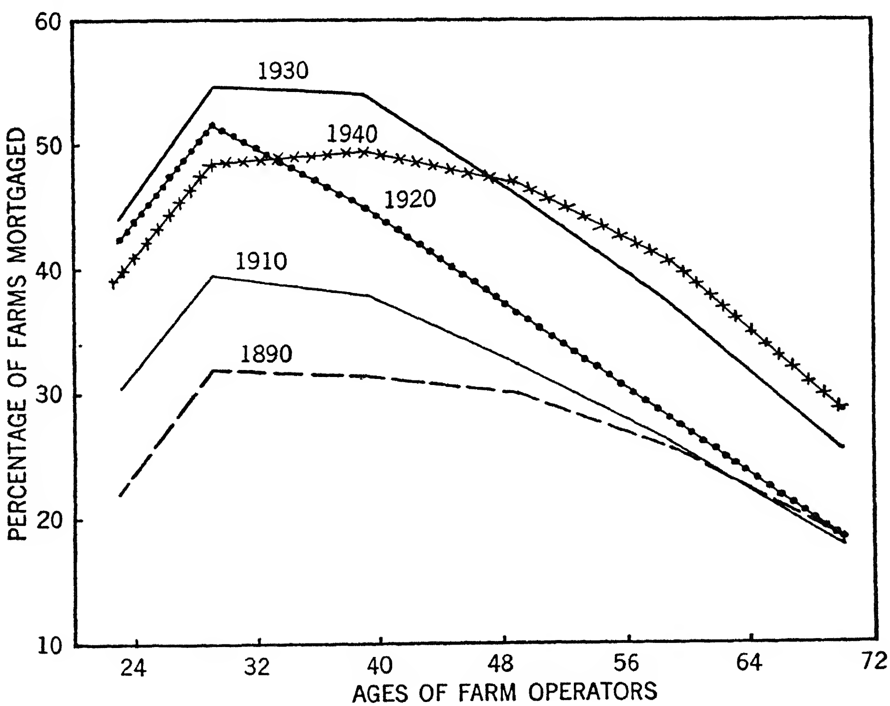

CHART 14. Percentages of full owner-operator farms mortgaged, according to the age of the operator, United States, 1890, 1910, 1920, 1930, and 1940.

peaks when the 1920 census was taken, and many young men had just bought farms at high prices under heavy mortgages. More of the older men had bought before the boom. Many of those with mortgages in 1940 had bought when levels were still relatively high in the 1920's.

Another factor in the situation is that as families have become smaller, more young men have acquired title in whole or in part through inheritance. But the effect of this appears to have been outweighed by other factors thus far, except possibly in 1940. Survey and accounting records do not generally show that those who inherit farms average higher net incomes than those who start with very little. Included in the group are always a number of relatively unsuccessful farmers living on inherited assets.

Although European farms have less land than those in this country, the land may be enough higher priced to offset this in part. For example, over half the farms in Switzerland have less than $12\frac{1}{2}$ acres and land values run from $350 to $800 an acre, with stock and equipment valued at as much as $100 to $150 an acre. Truck gardening land in Holland, Belgium, and Germany is equally high priced. In Denmark, farms of about average size (40 acres) were selling for $5,000 to $6,000 before the war. The machinery and equipment were valued at $1,000 to $1,500. The typical smallholding in Europe, however, is less of an investment than this. This is especially true in southern and southeastern Europe. More important is the fact that the families on these smallholdings make slow headway in reducing their mortgages. The gain during any one generation is lost when the estate is divided between the heirs. About 80 per cent of the agriculture of even Denmark, Switzerland, and Holland is financed on borrowed capital.[9]

FURTHER READING

* John D. Black and R. H. Allen, "The Growth of Farm Tenancy in the United States," *Quarterly Journal of Economics*, May, 1937.
* William T. Ham, "Farm Labor in an Era of Change, Farmers in a Changing World," *The Yearbook of Agriculture*, U.S.D.A., Washington, D. C., 1940.
* Paul V. Maris, "Farm Tenancy, Farmers in a Changing World," *The Yearbook of Agriculture*, U.S.D.A., Washington, D. C., 1940.

EXERCISES

1. Make a list of the jobs or tasks on farms in your community that can properly be called skilled; and of the major decisions that a regular hired man may have to make during the year.

[9] Yates, *op. cit.*, p. 63.

2. List the names of ten of the more successful farmers in your home area. Rank them from 1 to 10 as to success in farming. Then rank them from 1 to 10 according to each of the following qualities: (a) Technical knowledge; (b) Ability to buy and sell and make good business deals; (c) Industry; (d) Ability to handle hired labor. Compare the rankings.
3. Make a table showing the number of workers employed by months on a particular farm which you know.
4. If migrant labor is employed in your area, report upon its origin and routes of migration.
5. Make a rough classification of the types of landlords in your home area.
6. List in order of importance the methods of renting land followed in your home area.

CHAPTER V

The Ends of Farming

BEFORE WE SETTLE DOWN IN PART TWO TO THE TASK OF ANALYZING actual farms and their operation, we need to formulate our ideas as to aims and objectives. The test that will be applied in every determination made in this book will be *the effect on the net income of the farm.* But the term *net income* needs to be defined very carefully in such applications. Following are five propositions about the *net income* which is to be maximized in farming. Each of these is of the highest order of importance:

1. *The effect on the land must be counted as part of the net income in each instance.* The land is actually a changing inventory item, ordinarily with pluses or minuses accompanying each use of it.

2. *The effect on the well-being of the family is an even more vital part of net income than the effect on the land. The conservation of the land is really not an end in itself — the land needs to be conserved so as to contribute the maximum to human well-being over the years.*

3. *Net farm income must always be considered in terms of a particular time-span.* This time-span may be as short as a year in particular instances, but more often it is a whole lifetime or longer.

4. *The net incomes of individual farms cannot be considered solely by themselves.* Time and again, this book will point out that if many farmers follow the course of action that appears to pay best for the farm being analyzed and the situation in hand, the price of the product, or the prices of materials and services used in production, will be so affected that the individual farm incomes will be changed, for the worse or for the better. *Effects on group incomes must be considered as well as effects on individual incomes.*

5. *The net incomes of farmers as a whole, or of a group of farmers engaged in producing one product or set of products, can be reduced by turning out a larger quantity than will sell at reasonable prices.* While it is the role of farmers in civilization to produce foods and fibers cheaply so that all people are well fed and clothed, they cannot be expected to produce them at prices that buy them a poorer living than obtained by other groups.

It follows from these propositions that the net income to be maximized in farm management determinations is not simply a pecuniary net income measured in dollars. The dollar unit will be used constantly in the determinations in this book because it is the only over-all measure of economic value we have. But much will be added or subtracted that cannot be reduced to dollar values.

In fact, *one of the major rules of conduct followed in this textbook is not to attempt to reduce to dollar values those things that cannot honestly be so valued.*

In the rest of this chapter, we shall consider these five propositions in the order listed; only briefly, however — we shall get the full import of them only as we proceed to apply them chapter by chapter as we go forward.

CONSERVATION OF THE LAND

The need for weighing the effects of a given use of the land upon its plant-growing abilities is stressed in all the determinations made in analyzing systems of farming in PART TWO; and Chapter XXVII in PART FOUR is devoted entirely to problems in land management, nearly all of which involve conservation questions. No textbook pronouncements are needed to convince a student of agriculture that some uses of the land are soil-depleting, others soil-maintaining, and others soil-building; and that choice between land uses must take into account these differences as precisely as is practically possible. The task confronting the farm manager is that of weighing the various soil-depleting, soil-maintaining, and soil-building effects and of including these in his determinations as to what to produce, how to produce it, and the like. These effects include not only those on the nutrient content of the soil, but also those on structure, texture, and the like. Water and wind erosion may be much more important than any drain on the nutrients in the soil.

The use of the term *conservation* in this connection often leads to some confusion because it is used popularly, and even by scientists, in several senses. One popular meaning of conserve is simply to *refrain from using in the present, to save for use at some future time.* Another popular meaning is *not to waste*, or throw away recklessly; in this sense, we speak of conserving food or petroleum or natural gas. A more precise meaning is to *spread the use in a wise manner*, not too rapidly nor yet too slowly. We speak of conserving our coal, iron, and virgin timber in this sense, meaning not to refrain from using them, but to use them up at a certain rate that seems to be best.

None of these meanings, however, fits the conserving of the soil, for rarely have we in mind exhausting completely the soil resources of an area as we may a coal or an iron deposit. The crucial determination in soil conservation is the *level at which the soil productivity is maintained.* The land in a certain area may be maintained at a level that will yield an average of 600 pounds of cotton per acre, or 400, or 200. A pasture may be kept in a high state of fertility and of plant cover and support one cow to the acre; or may be allowed to retrograde and carry no more than a fourth of a cow. The problem in farm management is *which level pays best.* Changes in the economic environment or in technology may call for raising the maintenance level, or lowering it. They may call even for using up a large part of the soil resources of some area. Thus, it may pay at times to let the land run down until it is worn-out meadow or pasture ready to become a seedbed for old-field pine; or to deplete resources rapidly, like cutting old virgin timber to save stands that are still growing.

One common principle underlies the last two of these uses of the term conservation. It is *distribution of the use of resources over* time, or of *a choice between present and future uses,* with different distributions over time best under different circumstances. *The optimum use of resources is obtained when they are so used as to contribute the maximum to production over the whole time-span of their use.* The term will be used in this book only as including this principle; and when applied to land, will always have reference to some level of productivity which is being sought. This may be a higher level than at present, to be attained through various types of land improvement, but often will be only the present level; and occasionally it will be a level lower than the present, to be attained through reversion of the land to more extensive uses. It can easily be a level higher than that of the land in its virgin state.

THE HUMAN ENDS

Maximizing the human ends of farming involves something more than the conservation principle. *There is no limit to the level to which it is desirable to raise the human race.* But the conservation principle enters: There is at any time a choice between the well-being of the present generation and that of future generations. By working hard and denying itself, and investing its savings wisely, this generation of any nation, as of any family, may give the next a better opportunity than its own. Or it may waste present resources and hand down to the next a harder struggle for a living. The "friends of the land" of this generation have

set themselves the goal of handing down to another generation a patrimony of physical land resources that is better than the one they received. But conserving or even improving the land are of no value in themselves. They are important only as they contribute to larger human values. They have point only as a means to the end that later generations will possess the physical resources needed for a better life than the present one. The conservation of human resources in this sense may even call for the sacrifice of some present land resources for the sake of important human values — as during the war some land, and much timber, was exploited to serve other ends deemed more valuable.

Even more clearly, the ends of farming are not farming for its own sake. Not only do they not stop with running a successful farm business, but the success of the farm business itself is only a means to the real ends of human existence on farms. And *these are to live fuller and richer lives, and particularly to raise a new generation of farm people that is equipped for a better living than the present one.*

Better living on farms, as elsewhere, is built out of very concrete things, like food, housing, health, education, and security. Let us consider these briefly.

FOOD Good cash farm incomes devoted freely to food can buy good diets for farm families in the same way as for other families. The simple fact is that very many farm families cannot afford to buy meat, butter, cheese, eggs, potatoes, and vegetables, if they do not produce them themselves on their own farms. They simply do not have cash enough with which to buy them. One quarter of the farm families in the United States had farm incomes of less than $300 in 1939, including the value of products consumed by the family.[1] Probably half of the farm families in the United States do not sell enough commercial products to obtain the cash with which to buy adequate amounts of the foods named. If this is true in the United States, it is much more true in many other parts of the earth.

These farm families, however, have diets in general as good as those of urban families, and sometimes a little better. The reason for this is that they produce a large part of them on their farms. The national survey of consumer purchases made in 1936 gave the data in Table 6. The home-produced foods were valued in this survey at what they "would have paid for them had they been bought . . . from neighbors or from the most likely other place of purchase." [2] This is somewhat less

[1] Part of these also had off-the-farm earnings and other nonfarm income.

[2] "Family Food Consumption and Dietary Levels," *Consumer Purchases Study*, U.S.D.A. Misc. Pub. 405, 1941, p. 391.

than city consumers would have paid for them. Even on this basis, they represent half to two thirds of the food budgets.

TABLE 6. COST OF FOOD PURCHASED BY FARM FAMILIES, AND VALUE OF HOME-PRODUCED FOOD, IN SAMPLE AREAS OF THE UNITED STATES, 1936

States	*Purchased food*	*Home-produced food*	*Total*	*Per cent home-produced*
Vermont	$251	$190	$441	43
Pennsylvania — Ohio	182	321	503	63
North Dakota — Kansas	209	274	483	56
Washington — Oregon	207	279	486	57
North Carolina — South Carolina				
White owner-operators	172	453	625	72
White share-croppers	162	303	465	64
Negro share-croppers	142	185	327	56

Again, even though many farm families can afford to buy meats, dairy products, fruits, and vegetables, in case they do not produce them, they are not likely to do so freely enough to assure the family an adequate diet. If they have these available on their farms, they eat them much more liberally. Thus, the farm family which has a small orchard with no more than a dozen apple, pear, plum, and cherry trees, and a small planting of strawberries and raspberries, is likely to consume two or three times as many of these in season than if it has to buy them in the local stores. It is also likely to can many more of them and to have them available for use throughout the year. The new developments in quick freezing, combined with the increased availability of electricity on farms, is going to increase still further the advantage of producing these fruits on farms.

Quality is also a further factor. Both the flavor and the food values in fruits and vegetables produced in the home gardens are greatly superior to those of fruits and vegetables produced at a distance that stand around in containers and on display for days before they are consumed. The differences between fresh and market stocks of sweet corn, peas, and cabbage are always a great surprise when discovered anew.

The opportunity which living on a good farm affords to have an abundance of the foods necessary for a good diet, and also to eat for pure enjoyment, it should be apparent, is one of the great advantages of life on a farm. Many farm families, in addition, derive considerable satisfaction from the growing of fruits and vegetables for themselves.

The farm operators that place too much emphasis on cash income

may be blinded to the contribution made by the home garden, poultry flock, and dairy cows. These contributions need to be valued in terms of the variety which they give to the daily meals, their contributions to health through better nutrition, as well as the money they save at the store. What can take the place of the feeling of satisfaction after the first meal in the spring which includes strawberries from the home garden? or the first summer meal that includes cold watermelon? Now imagine settling down for the winter months with nothing on the pantry shelf except dry beans and peas, meal and flour, fatback and occasional fresh pork, syrup, and a limited quantity of sugar, lard, coffee, and tea. Add to this list a supply of eggs, sweet milk, buttermilk, cream and butter, and also green vegetables, either canned or fresh, depending on the season, and see how the outlook on life must change, and how the health of the family improves with these additions to the diet. If the money-minded farm operator is not convinced of the practical aspects of providing these from the farm, he and his wife should make up a budget showing what the nearest equivalent of these foods would cost at the store.

HOUSING In general, the housing of farm families in the United States is poorer than the diets. Only in the well-developed sections of the Midwest, in the Shenandoah Valley of Virginia, in the limestone areas of Kentucky and Tennessee, and in much of the Northeast and the Far West, can it be said that the usual farm home is adequate and at the same time comfortable. In most of the rest of the country, the prevalent type of farm dwelling is not even adequate for health, to say nothing about comfort and convenience.

The housing of farm laborers and share-croppers is still poorer. The housing for the operator family represents a return from the farm, whereas housing for the laborer and share-cropper represents a cost element. The experiences of farm operators in the commercial farming areas during the Second World War demonstrate the effective drawing-power of good housing upon farm workers. During the 1930's, the lack of employment opportunities caused many rural families to tolerate living conditions well below their simple human needs. There were no economic pressures prompting the farm operators to improve the houses for their workers. As workers began to drift away with the start of the defense period, the first concessions were slight increases in wages, and these were almost immediately supplemented by minor repairs on workers' houses. When materials became available after the war, these improvements were resumed.

Farm dwelling programs may, however, become too ambitious when they are publicly sponsored; they may be designed to conform to certain standards set up by urban-minded architects and home planners, who insist that farm families have a right to the same amenities and conveniences as city families of the same social status. Farm families may prize other values in living more highly. Also, many individual families trying to climb the ladder to home ownership may need farm equipment more than some of the appurtenances of urban housing. Those features of housing which are essential to health and efficiency need to be distinguished from those which are mainly matters of comfort and convenience. Farm families should share in the end as largely in these latter as do urban families, but they may not be the major consideration at all stages in the evolution of the individual farm family. After all, farm people have lived for a very long time without central heating systems and have slept in cold bedrooms, with no higher incidence of pneumonia and tuberculosis as a direct result. In many instances, the wise decision is to repair inexpensively the present home and get along with it until the family has its debt well under control.

On the other hand, there is equal danger that farm families will deprive themselves of housing benefits and of advantages that they can afford, and that the farm families as a whole will as a result simply deprive themselves of these advantages.

HEALTH The better human beings whom it is the primary object of a rural civilization to produce are first of all *healthy* individuals. Food and housing are more important because of what they mean to health than for any other reason. The importance of nutrition and its relation to health have been expressed as follows:

First and foremost:

Nutrition makes better human beings, which is the principal object of civilization.

Second:

Not only does it reduce greatly the amount of suffering and misery of people who are sick or half sick, but it increases incalculably the satisfaction and enjoyment in the experience of life.

Third:

It increases the output of the individuals of society by making them more productive, and makes it possible for them to have more goods and services, or work fewer hours, or more likely, some of both.

Fourth:

It accomplishes this last result particularly by increasing the proportion

of productive years in a lifetime. It broadens out the span of life in the working years around the prime of life.[3]

Farm people have a chance to be healthier than city people. They are much less exposed to communicable diseases and to many types of hazards. But their death and disease rates are only a little lower, and the difference is decreasing. The main reason for this is that farm people do not take as good care of themselves as urban people: and the reasons for this are partly low incomes, partly working too hard and not taking time off to look after themselves, and partly long-established habits of neglect and reliance upon "home remedies." Neglect of teeth, eyes, and throats are the commonest forms of health abuse on farms. Draft rejections for these causes were high in a majority of the rural sections. To take a somewhat extreme case, a survey in Dallas County, Missouri, located on the fringe of the Ozark Mountains, showed that only two dentists were serving 11,500 persons in the county, and one "eye-doctor" came into the county for one day a month, testing eyes and fitting glasses. The dental work was mostly pulling decayed teeth. The 258 families studied in this county were using 63 different home remedies for colds, 48 for burns, 45 for boils, 35 for coughs, 22 for influenza, and 15 for cuts.[4] Only one mother in five had received any prenatal care.

Levels of living and health are so closely knit together that it is almost impossible to decide which is cause and which is effect. The two improve or decline together. Take as another example the pellagra common in some sections of the South, as a direct result of diets containing too little milk and whole grain products, and too much dependence on fat meat, dry beans, corn meal and lard gravy. The victims of pellagra experience fatigue, listlessness, lack of ambition and interest in their own condition, and go through stages of irritability, inability to retain food, and extreme weakness sometimes ending in death. Although relatively few die of pellagra, many diets are just enough better so that the acute symptoms do not appear. It has been estimated that thirty persons have well-developed cases of pellagra for every one that dies of it, and that ten times this number have mild symptoms of it. The mild and constant fatigue accompanying incipient pellagra is often attributed to lack of ambition. The farmer so afflicted feels the urgent need to produce the crop required by the landowner. When this cash crop is cared for, however, he is tired to the point of being disinterested in raising the green

[3] *A Food and Nutrition Program for the Nation.* National Planning Association Planning Pamphlet No. 46, Washington, D. C., 1945, p. 1.

[4] Iola Meier and C. E. Lively, *Family Health Practices in Dallas County, Missouri*, Mo. Bull. 369, 1943, p. 16.

vegetables that he and his family need to better their physical condition. Thus, a cycle is set up that is difficult to break into with improvements. Especially is this true when we consider that pellagra has been present so long that it is not thought of as a condition that can be remedied, but rather is accepted as a normal handicap.

Much the same cycle has grown up around the hookworm infection still prevalent in parts of the South. Those afflicted have numerous small but constant internal hemorrhages. These produce an anemic-like condition, fatigue and a what's-the-use attitude. The family does not know that lack of proper home sanitation and sewage disposal are the cause of its ills and does nothing to remedy these conditions. Even though they may read that they should provide toilet facilities for the family, the remedy seems far removed from their condition. The farmer is tired, does not have the equipment at hand, and besides it is probably just one of those newfangled ideas.

Periodical testing for tuberculosis of the family milk cows has done much to cut down the spread of that disease. Testing for Bang's disease in the same methodical manner could do as much to check the insidious disease known as undulant fever.

The water supply of metropolitan areas undergoes daily and even hourly checks for purity. The average rural supply is checked only when there is a noticeable and disagreeable change in taste or color in the water. Shallow wells or springs are the most common source of water in rural areas. Many of the wells do not have sealed tops to keep out surface water, and in many sections the water is still drawn from open wells by bucket.

EDUCATION It is not necessary to present data or evidence as to the general inadequacy of many of the rural schools of this country. The expenditures on education per pupil for largely rural states vary from $27 per pupil to over $100. Chart 15 shows that the cities are no longer reproducing themselves and that the farms of this country have been rearing a considerable fraction of the future citizens of our cities. The young people coming to our cities from our farms are usually poorly educated and are often in poor health. Our cities can as little afford to have their recruits from the farms handicapped in this way as a dairy farmer can afford to have poor replacements for his herd. Cities derive their incomes in large part from the business they do with the people living roundabout them. Some of this income should be used to improve rural school education.

The education which farm children need is obviously of two kinds,

one which gives them a general preparation for the varied types of occupations which they may find in the cities, and the other which prepares them for working and living on farms. Farm boys commonly fail to learn on their home farms all the skills needed in modern agriculture. Even in dairy regions, many farm boys never learn to become good milkers from their parents because their parents have never become good milkers. Only on some of the farms can farm boys acquire the knowledge of feeding and soil management which is essential in modern

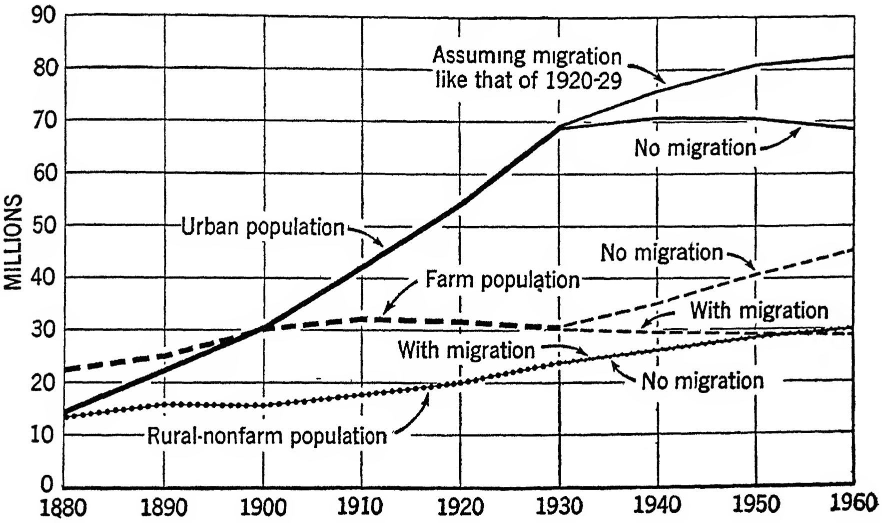

CHART 15. Urban farm and rural nonfarm population, 1880–1930, and pre-estimates for 1940, 1950, and 1960. (Adapted from Figure 67, *A Graphic Summary of Farm Labor and Population*, U. S. D. A. Misc. Pub. 265. The pre-estimates for 1940, 1950, and 1960 are those made by Thompson and Whelpton sometime before 1940. The 1940 farm population reported by the census was 30,547,000, around a million more than had been projected, because of the slackening of migration in the 1930's. The farm population before 1920 had to be estimated. The rural nonfarm population lives mostly in villages and cities of under 2,500. Note that it is expected to increase at the same rate with or without migration.)

agriculture. School education is therefore needed to supplement the apprenticeship education which the farms provide. The greatest shortcoming of home apprenticeship is usually in the business aspects of farming — in precisely the aspects of farming discussed in this book.

Once, at a state bankers' convention, a member rose and made a vigorous statement to the effect that the only place that a young man could learn to become a banker was behind the cashier's window and that it was useless to try to train bankers in the school of commerce

which had been set up at the state university. One of his fellow members rose and remarked that perhaps his fellow banker, who presumed to know everything a banker needed to know, could give him the answers to several questions that had been bothering him for some time. The questions were: (1) Why have interest rates been falling off 1 or 2 per cent all around us in the last ten years? (2) Are they going to stay this way, or are they going back up again? (3) What rate of return has a landlord a right to expect now on his investment in farms in this part of the country? (4) Are farms good buys at present prices?

Both elementary and high schools in farming regions can combine these two types of education very effectively. They can offer both to all students, and let the individual student divide his attention between them according to his interests and prospects.

From the standpoint of the family, the education of the children is like an investment in a capital good. The knowledge and skill which the boys and girls acquire is, like a machine or a land improvement, a product of past effort used in further production. The further product is important from the standpoint of the fortunes of the particular family, and of the progress of the nation. The larger the investment in increasing the productivity of those who make up the personnel of agriculture in each generation, the greater will be the total output of agriculture and the less the cost of foods and fibers to the nation.

SECURITY Farm family living is exposed to many personal hazards, as distinguished from the business hazards which will be discussed as financial problems in Chapter XXXII. The two, of course, cannot be kept altogether separate when family and business are closely associated as in agriculture. The obvious example of this is provision for old age; traditionally, farmers have looked to the building up of family estates to take care of them in later life. Losing a farm through foreclosure has thus meant the loss of the savings accumulated for old age. One of the major deficiencies of tenancy is that it does not provide this form of security.

The conventional method of providing against one major type of personal hazard is through life insurance. Farmers have been slow to take out life insurance. A survey made in 1935–1936 showed that only 43 per cent of white non-relief farm families were carrying insurance, and that these were paying annual premiums of only $88. For the net-income groups below $1,500, only 38 per cent were carrying insurance. These figures compare with 70 per cent for urban families.

Farmers have been slow to buy life insurance, in part because of their

traditional dependence on the building of estates, in part because they have hesitated to commit themselves to making definite insurance payments each year in view of the uncertainty of their income, and in part because life insurance takes a relatively high slice out of the average farmer's cash income. The best time to take out insurance is in early life, and this is the period when young farmers are trying to accumulate the means wherewith to buy working capital and start farming.

The Social Security Act of 1935 and its later additions made available another type of provision against old age, namely, old age and survivors' insurance. However, farmers and even hired farm laborers were excluded from these provisions. The Act was even amended in 1939 in such a way as to deprive an additional 500,000 workers in agricultural plants of various descriptions from such protection.

THE TIME-SPAN

The problem of the time-span in agriculture needs to be considered from the point of view of the farm as a pure business, and from the point of view of the family. Let us take the business point of view first. As a purely business matter, the farmer who rents a farm for cash for a year has only to balance the expected receipts and expenditures of the possible alternative programs in order to determine which will pay best. The business time-span in this case is one year. With a five-year cash lease, each decision is based on maximizing the net farm income over a five-year span. The landlord has a longer time-span than the tenant only if he is not expecting to sell the farm at the end of the lease. Ordinarily, he will want to maximize his returns from ownership over a considerably longer period. And surely this is true of the usual owner-operator.

In attempting to maximize their returns over longer spans, the landlords and owner-operators must do two kinds of balancing: (1) annual incomes from the farms plus gains or losses in the values of the farms depending upon how they are farmed each year; (2) annual incomes in different years. Under the first head, so much may be taken out of the farm from year to year that it depreciates more than the extra annual income from this exploitation; or the opposite of this course may be followed. As a pure business matter, some course between these extremes and inclining toward the first, usually pays best. Under the second head, so much may be taken from the farm in the first ten years that the incomes are very poor in the last ten — as a distance runner may run so hard in the first half mile that he loses his race by his slow pace in the last quarter.

Suppose the farm is a family farm, however, and that the father expects to hand it over to one of his sons, and hopes his son will do the same. What then is the time-span? Unquestionably, the whole working lifetime of the present farmer; and theoretically an indefinite period longer. If each generation of the family tries to leave to the next a better farm than it received, each succeeding generation will live better than the present. The practical working time-span is therefore a generation with such a goal.

The many farm management decisions that involve human as well as business values are likely to have relatively long time-spans. Thus a decision to rent for another three years before buying a farm brings into purview the whole family life cycle; or a decision to buy the Daniels farm of 160 acres instead of the Neff 80-acre farm may involve the question as to whether the oldest son wants to work on the farm when he finishes high school.

The time-span for the nation is, of course, also without any theoretical limit. Practically, many decisions are made in part on the assumption that the more distant future will be able to take care of itself. And as with family planning, if each generation leaves at least an undiminished patrimony, a practical solution of the problem is achieved.

BUSINESS VERSUS FAMILY

Reference has just been made to the business ends and the human ends of farming as if they were distinct; yet repeatedly it has been stated that both need to be weighed in the balance in any decisions that are made. Apparently some further discussion of the reconciling of these ends is needed.

That farming offers an unusual opportunity for combining business ends and the real ends of human existence, has already been stressed in our discussion of "Farming as a Mode of Living" in Chapter III. It was there pointed out that a very large part of the fullness and richness of living comes from the satisfactions one gets from one's work, especially when one is working for oneself.[5] Although many operations on a farm are highly routine, farm work offers more variety over the year than almost any important occupation that can be named, and how this work is done strongly conditions the product. Farm people as a result derive a tremendous amount of satisfaction from their work, and this adds greatly to the meaningfulness of their lives. The highly special-

[5] Thorstein Veblen devoted a whole book to discussing these satisfactions under the name *The Instinct of Workmanship*, 1914.

ized crops generally have the strongest appeal to the instinct of workmanship — crops like cotton, tobacco, potatoes, and the fruits. But growing livestock often makes a stronger appeal than growing crops.

Another important way in which agriculture contributes to better living is that it does an unusually good job of developing and training its oncoming generation of workers and managers. As indicated above, the farm work alone does not provide enough of such development for one who is later to operate a family farm of his own, not even when combined with the elementary education of the rural schools; but it goes a long way in that direction if the boy grows up on a good farm.

Third, the farm family as a unit by itself, with all of its members sharing in the joint farm and family undertaking, provides a kind of group life that is essential to human beings. The common meaning of the statement that farming is a mode of living rather than just a business or occupation is that the farming and the living are more nearly *one and the same experience* than when the business is carried on in an office or shop downtown, or the workers of the family are working for a wage or salary in someone else's factory, shop, or store. From the time that the farm family rises in the morning until the chores are finished at night, the work going forward on the farm dominates much of the thinking of the whole family, and in large part determines the direction of its efforts. Therefore, they who choose to be farmers must choose to live farming as well as to work at it.

Fourth, the activities of the families making up a neighborhood or larger unit, both those having to do with the farm and those having to do with the household, are of such a nature as to bring them together in frequent association and provide a community life outside the family.

It must be confessed, however, that the third and fourth of these have become less important in the last two decades as automobiles and radios have brought commercial amusements within easy reach of farm families.

That the business and human ends of farming may conflict is obvious in such simple cases as when members of the family work so hard at farming that they injure their health; or when the family is so bent on making a success of its farm business that it fails to equip the children adequately for their lives; or when the family gets so absorbed in the business that it takes little or no part in the larger life of the community and the affairs of the state and nation. As we proceed from chapter to chapter in this book, we shall time and again introduce decisions that weigh against business income such things as the education of the family, its health, its security, and provision for its old age, and also its comfort

and leisure. We shall see additions to, or subtractions from, net income weighed against additional or fewer days of labor, or hours of work per day; or the need for additional income, and the importance of the use to which it is put, weighed against the extra labor required.

The considerations involved may also be a mere matter of preference or prejudice — the farmer and his family simply do not want to adopt changes in farm organization or practice that would increase the farm income. They may not want to take on the extra labor needed in caring for more cows, or of "making hay all summer" if they shift from clover and timothy to alfalfa, or to accept the restrictions upon their freedom of action imposed by shifting from hogs or beef cattle to dairying, or to do the extra work involved in taking on a supplementary enterprise, like a canning crop, even though it may fit into the season's round of farm activities with very little conflict. On the other hand, enterprises may be added largely because members of the family are intrigued by them, or because they make the year's round of activities on the farm more complete and more interesting. The pleasure in seeing plants and animals grow, and helping them to grow, extends on many farms to the point of wanting to see all the plants and animals grow that can be accommodated on one farm. Many thousands of farmers still grow a field of wheat in most years "for sentimental reasons," which means largely because they used to grow it as an income crop and still like to see it grow. The time may come when many thousands of farmers in the Piedmont and Brown Loam sections of the South will grow a little cotton for the same reason.

Industrial workers have struggled almost as hard over the last century for better "working conditions" as for better wages. In working conditions, they have included hours of labor, physical strain, rate of work, safety and comfort in the working place, sanitation, and the like. Farm workers should have as much concern over working conditions as other workers. Machinery and power have lightened farm work importantly in the past century. We will show in a later chapter how output per worker has increased in agriculture in this country since 1910, but that hours of labor in farming have shortened very little. In industry, in contrast, the hours have been reduced a fourth in the same period. The war years saw the working time increased for both groups. The farm machinery now available again will enable farmers to get their work done more quickly and with less effort. It can also shorten hours if farm people are able to adjust themselves to the new conditions. But most of all it can reduce the heavy toil or monotony of many farm tasks.

Another principle of conduct to be derived from these circumstances, also to be developed in a later chapter, is that spending either very freely or very cautiously is unwise either for individual families or for all of agriculture. This general rule needs, however, to be varied either way to fit the particular circumstances in which the individual family finds itself. In the two decades between the wars, altogether too many individual families were in a position where they dared not spend as freely as was good for agriculture as a whole, or for the nation as a whole. Even in more normal times, too large a fraction of the farm families of this country are still likely to be in this state.

In Chapters VII, VIII, and IX, we shall see very clearly the relation between volume of output, prices, and net income. More potatoes, tobacco, wheat, and milk would all increase the net incomes of their producers if the larger product would sell at the same price as present product; but often not so when account is taken of the lower price of the whole output. Either working longer hours to produce more, or investing income in more livestock and equipment instead of spending it on better housing, may defeat the very ends sought if not well timed.

POPULATION AND NET INCOME

The most basic of all factors in determining net income is the ratio of the population to other resources. Chart 16 shows a wide range in the amount of agricultural property, including land, buildings, and working capital, used per worker in the different states, from down around $1,400 in a group of Southern states, to eight times this amount in a few Western states, with net farm incomes per worker in direct proportion. Human labor is not used very effectively in the states at the bottom of this scale. A unit of it does not have much land and other resources working with it. Climate, heredity, and related factors are also supposed to produce important differences in the relative efficiencies of workers in different regions. Much of what is said on this subject is in terms of a definition of efficiency that confuses it with mere output per unit of man labor, without regard to the amount of the other productive factors used. In the more exact sense of the term — output per unit of land and other factors used with labor — important differences among regions still remain. But we have no way of measuring these exactly, and they may be the result of malnutrition in childhood and afterwards, rather than of differences in climate and heredity. These differences will continue till the rate of migration from these states is increased and birth rates decline.

If we may judge from Chart 15, the ratio of farm population to resources must have declined for the country as a whole from 1920 to 1929. Given future migration from farm to city at its 1920–1929 rate, this ratio will decline further. The urban population, that of cities of 2,500 and over, will decline from now on without this migration, according to the chart, and the nonfarm rural population — that of cities and villages less

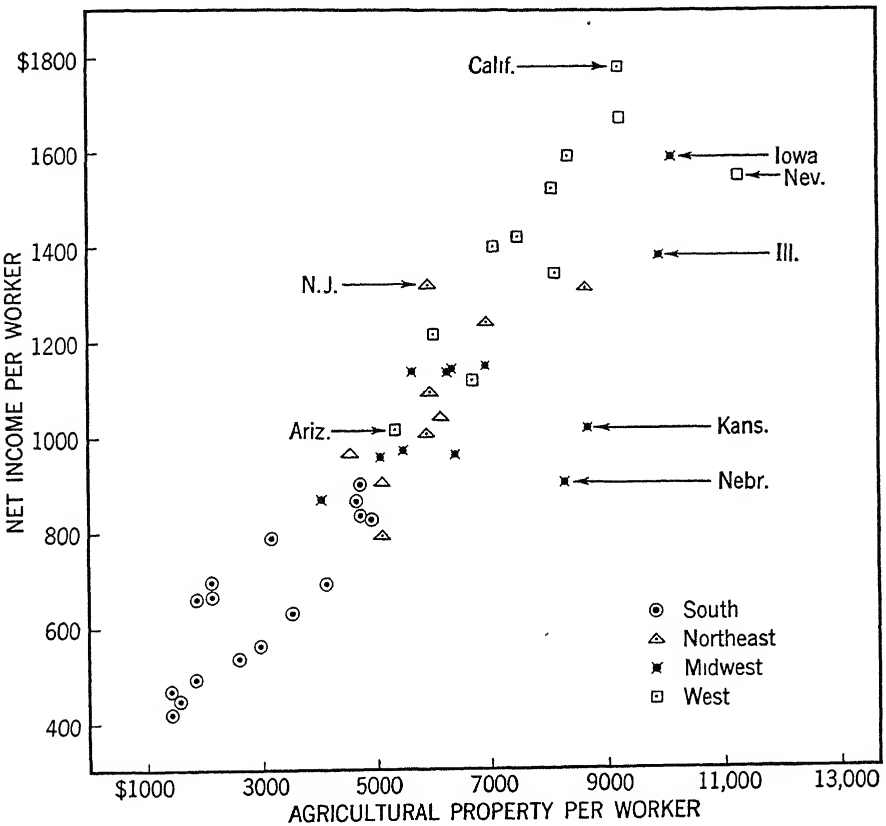

CHART 16. Relation of agricultural property per worker in 1940 to net farm income per worker, 1935–1939.

than 2,500, and other rural nonfarm territory — will continue to increase at about the same rate as since 1920. This decline in the ratio of population to resources will mean more income per worker on farms. Should the migration from farms to the cities be at a slower rate than in the 1920's, the ratio of population to resources might still decline, but it would be more slowly. The farms in such a case would maintain production at a high level, prices of farm products would be under constant

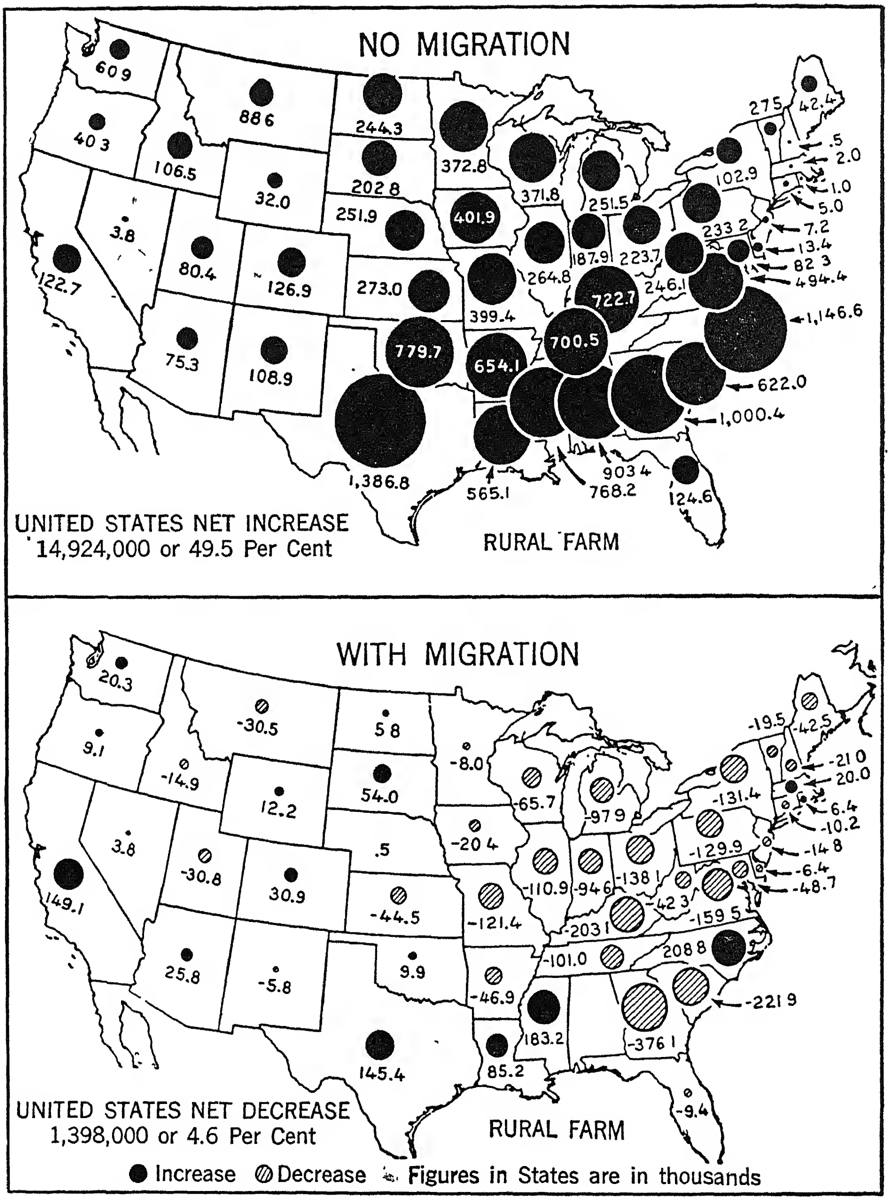

CHART 17. Rural farm population by states, estimated change with and without migration, 1930–1960. (Adapted from Figure 66, *A Graphic Summary of Farm Labor and Population,* U. S. D. A. Misc. Pub. 265.)

pressure, and the terms of trade would be against agriculture as they were most of the time in the two decades between the wars.

Whatever may happen to the national average, surely the farm population will decline in many of the states. Chart 17 presents comparable pre-estimates made by the Department of Agriculture for the increase in rural farm population by 1960, first, in case there is no migration to the cities, and second, in case migration takes place at the same rate as in the 1920's before the Big Depression. The only states expected to show an increase in the latter case are a few in the South and in the West in which farms are still being developed.

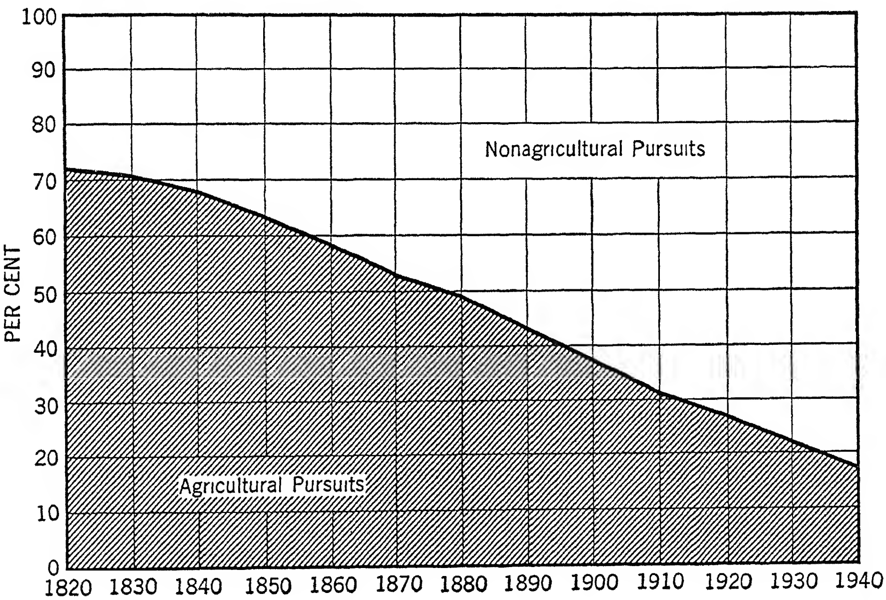

CHART 18. Proportion of the nation's labor force engaged in agriculture, 1820–1940.

The high point in number of farm workers, according to revised census data, was 11,592,000 in 1910. This was a gain of 3,000,000 from 1880, and of 8,000,000 from 1840. The 1920 census showed a slight decline; the 1930, a decline of over a million; and the 1940, a further decline of 1,300,000. There is reason to believe, however, that the 1930 census omitted some of the farm population and farm labor force along with its omitted farms.[7] More accurate figures would indicate some flattening out in the decline in the period between the wars. Chart 18, reproduced exactly from a release of the Bureau of the Census, shows

[7] *Comparative Occupation Statistics for the United States, 1870–1940*, Bureau of the Census, p. 25.

how the nation's labor force has shifted from agriculture to nonagriculture. The decline has followed almost a straight line since 1850. In terms of percentages of total labor force, 69 per cent were employed in agriculture in 1840, 49 per cent in 1880, 31 per cent in 1910, 21 per cent in 1930, and 18 per cent in 1940.

If one were to take Chart 18 literally, one would reach the startling conclusion that by 1980 no one will be working on farms. If there has been no slackening in the decline in the last ninety years, why one in the next forty? Of course, you will say that the line will have to flatten out sometime soon. But this is what students of agriculture have been saying for the last fifty years.

FURTHER READING

*"Farmers in a Changing World," *1940 Yearbook of Agriculture*, pp. 827–940, 1033–74.

Vermont Commission on Country Life, *Rural Vermont, A Program for the Future*, Burlington, Vermont, 1931.

R. B. Vance, *Human Factors in Cotton Culture; a Study in the Social Geography of the American South.* Chapel Hill University of North Carolina Press, 1929.

EXERCISES

1. Make a list of the soil-depleting, soil-maintaining, and soil-building crops or land uses on farms in your home area.
2. Single out five farms which you know and rank them according to the level at which their soils are being maintained. What accounts for the differences?
3. How does a farmer in your territory who builds a new barn plan to get back his investment?
4. Under what circumstances do you feel that a farmer should put his available liquid capital into a new piece of farm machinery instead of new conveniences for the home, such as an electric refrigerator? Under what circumstances should he do the opposite?
5. If you are going farming when you are through college, or would like to do so, what do you expect in the way of income, living conditions, security, etc.?

CHAPTER VI

Farming in a Changing World

THE LAST SECTION OF CHAPTER I, CALLED "FARM MANAGEMENT LOOKS Ahead," made clear the essentially dynamic character of successful farm management, and pointed out that except for the shifting economic environment of agriculture, and the developing technology, the science of farm management would not exist. The task of this chapter is to reveal more fully the nature of these shifts and developments. Many farmers protest against the uncertainties with which they must cope, and it is not difficult to understand why they do so. They would like to produce freely whatever their farms are well qualified to produce, and to be sure of getting a fair return for it. Some of them are therefore always asking to have the prices of their products guaranteed at "cost of production" or some other figure. They have in the last ten years or so looked with favor on programs to have the government buy the "surpluses" of large crops and to hold them in some kind of "ever-normal granary" till a short crop comes along. This chapter will make very clear that more is involved in the uncertainties of agriculture than irregularly alternating good and bad crops.

The overwhelming facts of the situation are that *modern agriculture cannot operate in isolation, but is closely tied in with the rest of the national economy;* that *it is also tied in inescapably*, practically speaking, *with the agriculture of the rest of the world, and the economies of other countries;* and *that the agriculture and the economies of other countries as well as of our own, are in constant flux in large measure in unison with ours because of mutual interdependence and subjection to powerful common influences.*

The close interdependence of our agriculture and of the rest of our economy, and of our agriculture and that of the world are sensed more fully now than not long since. In the ten years after 1930, the farm people of this country as in others suffered from weak markets and low prices as at no time since 1893–1895, in spite of the most vigorous public measures ever taken. Unemployment in this country was still around ten millions at the end of the decade. By 1943, full employment, plus

the military needs for food and textiles, had raised farm prices above the level of other prices. Somewhere near full employment in this and other countries is needed to maintain a balance between agricultural and other prices in these years after the war. Without such a balance, farming is severely handicapped.

If thirty years ago one had tried to talk to an ordinary farmer in this country about how the people of India, China, or Russia farm, one might have stirred up a little curiosity; but no real concern. Today the farmers of this country realize that wheat, corn, sugar, rice, soybeans, fats and oils, and cotton, wool, silk, jute, and competing fibers, are world products; and that what Russia, China, India, and other nations do in producing them determines in an important way the best way to organize their own farms. The two world wars have helped them to understand this.

CONNECTIONS WITH THE GENERAL ECONOMY

A very few exhibits will suffice to show the ways in which agriculture is tied in with the economy in general. Concrete instances of it are the shifts in production induced by transportation developments, from the turnpike to the canal, to the railroad, to the truck, and now beginning in a small way to air express; the shifts caused by the gasoline engine, which substituted gasoline for fifty million acres of crops formerly grown to fèed horses in this country, and which made it possible to grow crops

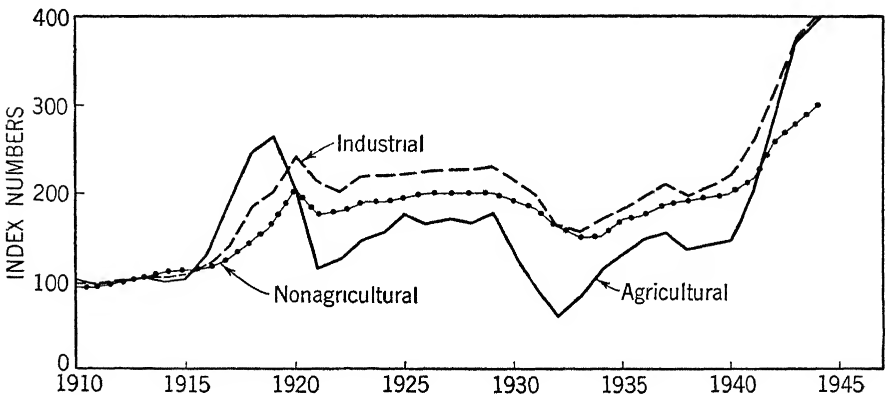

CHART 19. Index numbers of net farm income per worker on farms, and of annual earnings of nonfarm workers, 1910–1944, with the averages of 1910–1914 taken as 100 in each case. (Adapted from Chart VII, in John D. Black, *Parity, Parity, Parity*, Harvard Committee on Research in the Social Sciences, Cambridge, Mass., 1942, Chap. VII, p. 94.)

on almost as large an acreage of semiarid land; and the increase in cigarette tobacco production and decrease in cigar tobacco production resulting from changes in smoking habits.

Of more profound and wider significance are such relations as those between farm and nonfarm income per worker shown in Chart 19. The nonfarm series takes account of employment as well as wage rates, and the farm series takes account of volume of production as well as prices. Both series are expressed in index numbers, that is, as percentages of the average for the years 1910–1914 taken as 100 per cent. What we are interested in here, however, is not whether farm or nonfarm incomes are the higher, but how they have changed with respect to each other. Clearly the two income series have moved roughly in parallel. Farm incomes rose more sharply in the First World War, but dropped suddenly in 1920. Nonfarm earnings declined more in the early 1930's, but recovered more in 1934–1940, and rose further during the war.

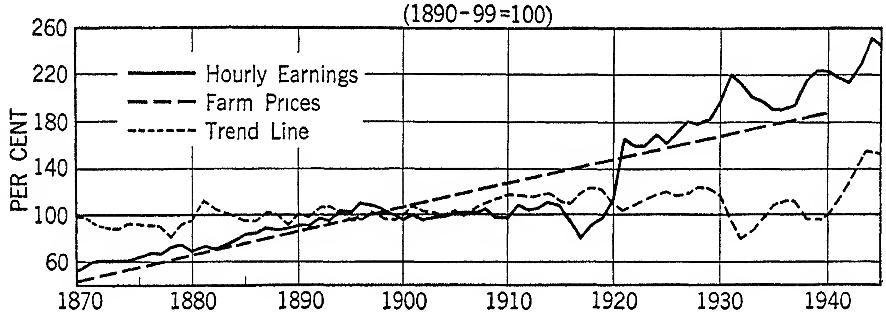

CHART 20. Index numbers of real farm prices and real nonfarm hourly wage rates, 1869 to 1944, with the average of 1890–1899 taken as 100 in each case. (Adapted from Chart VI, Chap. VI in John D. Black, *op. cit.*)

Equally important is the fact, however, that nonfarm earnings came out of the First World War on a level relatively much higher than before, and have retained that high level ever since except during the severe unemployment of 1931–1933. This resulted from a more than doubling of money wage rates during and just after the First World War, and an increase of at least a half in *real* wages shown in Chart 20. This chart lays out the course of *real* farm prices and *real* hourly wage rates over a stretch of seventy-five years. Real wage rates, that is, purchasing-power wage rates, were determined by dividing the index number of money wage rates by the index number of the general price level. Similarly, real farm prices were calculated by dividing the index numbers of farm prices by the index numbers of the price level. Note how wage rates rose the faster for the first thirty years, lagged until 1917,

and then broke sharply upward. As a result of this sharp rise, farm machinery prices, farm building costs, freight rates, middlemen's margins, and even tax rates rose.

It has been argued by some that since farm and nonfarm incomes change as nearly together as indicated by Chart 19, the nonfarm incomes must determine the farm incomes, and that therefore farmers should be interested in high wages for urban workers. Others have insisted that the causal sequence runs the other way, and that factory workers should therefore want higher prices for farm products. The obvious causal connection is neither of these, but instead that both movements are caused by the things that cause alternating prosperity and depression, and war and peace.[1]

Also some have been disposed to explain the interrelationship wholly in terms of movements of the general price level. That farm and other prices move closely together is evident in Chart 21; but that Chart 21 alone will not explain Chart 19 is obvious from Chart 20. However, until the First World War at least, general price levels had long-run trends of their own occasioned by changes in the supply of gold and silver. The upward sweep of prices from 1895 to 1917 caused in this way had a strong impact on agriculture, among other things laying a foundation for the disastrous boom in the land market in 1917–1920.

WORLD CONNECTIONS

To exemplify concretely the connections of the agriculture even of a large and diversified country like the United States with the rest of the world, one only needs to think of how wool, grown at some period commercially in most of the northern two thirds of this country, is now produced in volume only in the range and mountain states of the West, the rest of the nation's supply coming from similar regions elsewhere in the world; of how wheat growing similarly crossed the continent from east to west, and is now mainly confined to the Great Plains, and to other similar regions in Canada, Australia, and Argentina which are now supplying most of Europe's deficits; and of how this nation, just after the last war, was supplying 45 per cent of the foreign mill consumption of cotton, and just before this war, only 20 per cent of it, because other countries have increased their cotton acreages, and now, in addition, are substituting synthetic fibers for cotton increasingly.

Similar statements could be made about sugar, lard and vegetable oils, flaxseed, rice, and a list of minor products. It is true that this nation

[1] This subject is explored more carefully in Chapter XLVIII.

could exist without any imports or exports of farm products; but it would live well below its present levels, and the most that any ardent "protectionists" urge is that we produce at home all we use of some product like wool or sugar in which they are particularly interested.

That our agriculture has world connections of wider and deeper significance than those of single commodities is evident from the fact that the sudden increase in wage rates shown in Chart 20 also took place

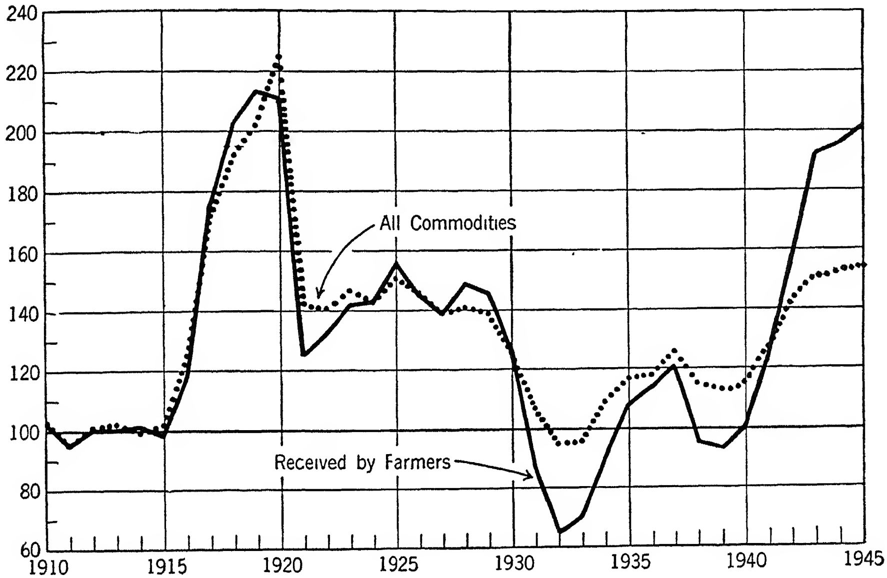

CHART 21. Index numbers of prices received by farmers and of wholesale prices of all commodities, with 1910–1914 = 100.

in the United Kingdom and on the continent of Europe; that the relative levels of farm and other prices, and of farm and other incomes, move closely together in all those countries which are in important trade relations with each other; and that except for small differences in timing, the major and even most of the minor cycles of business activity fall into the same pattern; and that movements in the general price level, both cyclical and trend, have about the same pattern the world over.

PATTERNS OF CHANGE

We will be helped in our discernment of the ceaseless ebb and flow of economic and other change affecting agriculture if we distinguish and classify their different patterns. First is the familiar distinction

between *trends* and *cycles*, the trends being all up or all down, and the cycles up and down alternately. Cycles, in the ordinary use of the term in economics, need have no regular period. Movements induced by events that occur only once, like the discovery of the New World, or irregularly like wars, will be referred to in this book as episodes, or as *episodic*. The cycles which farmers need to take into account are the familiar business cycles, now generally accepted as coming in two sizes, major and minor, the first running from 7 to 10 years and averaging 8.0 years since 1857, the second running 3 or 4 years and averaging 3.4 years since 1890. The major cycle includes an upswing and downturn in the rate of investment in fixed capital; the minor cycle, similar swings in the inventories of commodities. Economists now also talk of a building cycle which has averaged 17 years in length since 1830, the last peak in which was due in 1943. Some economists are also inclined to accept a theory about the existence of 20- to 30-year periods of alternating good and bad times. This last period of good times, according to this theory, was 1897 to 1920, and the succeeding period of bad times should be coming to an end soon now.[2] A few even consider wars, or tendencies to war, as regular events in such a sequence.

Particular industries or lines of production also have cycles of their own. Arthur F. Burns studied the "trend-cycles" for 104 industries in his *Production Trends in the United States since 1870*.[3] The hog-corn cycle is familiar to all students of agriculture; how many other such production cycles there are is not clearly established, but there has been discussion of beef cycles, cow cycles, sheep cycles, poultry cycles, apple cycles, and once upon a time, horse cycles.

Adjusting farm production to fit into this complex set of cyclical patterns, and the episodes constantly besetting agriculture, such as wars, shifts in consumers' wants, and new forms of competition, is one of the major responsibilities of a farm operator. Succeeding chapters furnish repeated examples of such adjustments, and Chapter XX outlines the principles involved. In the rest of this chapter, we shall deal only with the longer sweeps of change. The trends we shall note are not always in the same direction, and the rate of change may be highly variable; but no one has yet convinced his fellow man that they include cycles.

If these movements are so prolonged, you may ask why a farm operator with only one lifetime to live need concern himself with them. The

[2] See Chapter 1 in Alvin Hansen's *Fiscal Policy and Business Cycles*, New York, W. W. Norton and Company, 1941.

[3] *Production Trends in the United States since 1870*, National Bureau of Economic Research, New York, 1934.

answer is that though they operate slowly, they are exerting their effects constantly, and all of us are able to act more sensibly if we understand the forces bearing down on us. Then, too, most of the time, we are inclined to accept as best that to which we are accustomed and to condemn changes for the better merely because they are changes. It is also helpful to understand what is happening to other peoples with whom we trade or compete.

The interdependence of agriculture and the rest of the economy, we shall discover, is not new in the world. But in earlier times it ran largely the other way — upon the size of the harvest depended how well even the Romans lived each year. As medieval organization broke down, the emerging towns and cities acquired an economic basis of their own, and upon how well they prospered not only depended the demand for farm products, but also the jobs for the surplus young people of the farms — for farm populations almost everywhere pressed heavily on the means of subsistence until the New World was opened for settlement.

SOCIAL ORGANIZATION

The several so-called stages through which the human race has passed from direct appropriation and pastoral through hoe culture, settled agriculture, town-and-country economy, the factory system, the Industrial Revolution, and the present highly industrial economy of the Western world, are of interest not so much in themselves as because they represent a trend. We surely have no reason for thinking that the trend which they represent has reached its limit, and that the human race is not even now evolving still another form of social organization. The human mind should be alert to discover this new form and assist in its orderly progression and not resist it as evil because it is unfamiliar.

Although these stages represent a trend, the exact nature of the trend has differed much by countries. The Eskimos, to begin with, are still living in large part by direct appropriation because crop growing in the far north is impossible; and a good part of the livelihood of the people of Norway and Siberia is still obtained directly from the sea. There are more reasons than ordinarily supposed why many of the peoples of central Africa, and the tropics generally, depend in large measure on natural foods.

Again, the peoples living in semiarid treeless countries have had a different sequence than those who settled down in the forests. The most that has happened to the nomads is that they have settled down

to the extent of having permanent abodes for their families while they follow their flocks during the pasture season. We shall see later that much of the sheep and cattle ranching of our own country still follows such a pattern.[4]

The process of the settling down of peoples into villages probably began ten thousand years ago in Egypt or Babylonia or China, and it is not yet completed. The Greeks had already settled when the Iliad was composed about 1000 B.C. The Britons were settling down during the period of the Roman occupation, from the first to the fifth centuries A.D. The Franks settled down in present France during the fifth century A.D., and the Magyars in present Hungary in the tenth century A.D. The Algerian tribesmen, according to Professor N. S. B. Gras, are in the process of settling down at present, some of them already living in houses the year round, some in houses only part of the year, and some still roving and living in tents. The Kirghiz and some other peoples of central Asia are also slowly settling down.[5]

One scarcely wishes to call the hand culture still practiced over much of the world nothing more than the hoe culture practiced in the early forest clearings; but the gap between them is not very wide. Japan's 5,575,000 farms in 1930 had only 1,280,000 work horses and 615,000 work cows. Belgium's 1,131,000 tiny holdings, three quarters of them under 1½ acres, had only 194,000 horses and 14,000 oxen. Italy's 4,196,000 holdings had an average of 0.3 of a horse, mule, or ass, and 0.5 of an ox or work cow. The farms of Czechoslovakia averaged 0.4 of a horse and 0.7 of an ox or work cow, and Austria's about the same. Thus even in Europe, many millions of little farms have no work animals at all, and they do not have garden tractors! They may have their land plowed for them by a neighbor, but after that, their farming is hoe culture all the way — as on most of the fifteen million village and city Victory gardens in this country during the war.

These people do not use work animals for pretty much the same reasons that the early forest dweller did not: food could not be spared to feed animals. It was all needed to keep the human population alive over the winter. An acre of wheat in the United States today will provide twenty-five times as many meals if eaten directly than if fed to a modern beef animal first; three times as many if fed to a modern dairy cow first and the milk is consumed whole; five times as many if the milk is made into cheese. As a way of getting human food out of grass in the

[4] See Chapters XLIV and XLV on "Cattle Ranching" and "Sheep Ranching."

[5] N. S. B. Gras, *Introduction to Economic History*, New York, F. S. Crofts and Company, 1922, pp. 51–52

plains, cattle and sheep were excellent. But not to convert cropland into human food.

Primitive living was almost all agricultural, because people had to live close to the land to obtain the food, clothing, and shelter they needed. But today certain large nations are still 80 to 90 per cent rural. India, with 400,000,000 people, nearly a fifth of the human race, was 89 per cent rural in 1931, and two thirds of her people were making their living from farming. China, probably with 450,000,000 people, is almost as much agricultural as India, if we count silkworms as a form of animal husbandry. Until 1920, European Russia was more than 80 per cent rural. These dense populations still live from the land almost directly and work their land largely by hand, because of their high ratio of population to resources and consequent low levels of living. Russia has made great progress away from these conditions since her Industrial Revolution began in earnest in the 1920's. Japan has made less because her population presses acutely on the food supply. What China and India are able to do in the way of industrializing has tremendous import for the agriculture of the rest of the world. They *might* become important food-deficit countries.

In our own country, hand culture still dominates the agriculture of some mountain areas. More important, a large fraction of the labor on two important crops, cotton and tobacco, is still by hand.

Specialization by occupations first became important when craftsmen appeared in the villages and towns and exchanged their wares for food and raw materials. The craftsmen in an English village or town included the millers, bakers, chandlers, furriers, drapers, tailors, saddlers, smiths, carpenters, coopers, joiners, plumbers, barbers, etc. The farmers roundabout supplied them not only with cereals, meat, cheese, butter, beer and wine, but with wool yarn, flax, hides, lumber, and charcoal. The farm people did not give up their homecrafts at once, but the village craftsmen had advantage over them because they were specialists. They in turn organized into craft *guilds* to protect their interests. They had rules about the quality of their work, and also about entrance into their guilds that would make modern labor unions envious. The merchants, also growing in numbers, combined into merchant guilds. In the parts of the Old World which the Industrial Revolution has not reached, this kind of an economy still prevails. This means in most of China and India, and west to include a large part of Turkey. Most of Old Russia was similarly organized except on its western border. One may find the guilds still flourishing in many of the towns and cities of these countries.

Specialization by areas and regions began with the differentiation of the towns. Some remained largely farming, with only a little manufacturing. Others became dominantly industrial. Trade increased especially in those that were located in seaports or at strategic points on rivers. These groups of workers in turn had to be served. They needed houses and house furnishings as well as food and clothing. When this stage was reached, the economy had really differentiated into the two parts that we now know — urban and rural, *town* and *country*.

The markets widened with the growth of navigation as well as with improvements in internal transport. To obtain the products needed to meet their outside demands, the merchants developed the system of "putting out" materials to be manufactured in homes — in village homes as well as in town homes — and collecting the finished product. The growth of manufacturing thereafter for a hundred years or so in England was more in the villages than in the towns. The colonies in North America were mostly developed at a time when the putting-out, or "domestic" system as it was sometimes called, was at its height in England, and it was this system of manufacturing that was first planted on this continent.

The Industrial Revolution, which brought the *factory system*, is usually dated from around 1775 in England. It came later on the Continent. Factories had begun to develop before this — they were simply large spaces under one roof where many persons worked by hand at the same or related tasks. With the introduction of steam power, and the invention of machines that could use this power, manufacturing was almost completely reorganized, first in the textile and other light industries, and eventually in the metal industries.

Sometimes the Industrial Revolution is spoken of as having ended in England in 1840. All that is meant by this is that the spread of the factory system had by then practically reached its limits. Industry kept on growing after that. It is still growing in the countries first to adopt the factory system — not however, by converting more handicraft into machine production, but by producing new things for people to buy with their increasing incomes, and substituting still more power for labor in the manufacturing process. Manufacturing output more than doubled in the United States from 1910 to 1940 — automobiles, tractors, refrigerators, radios and electrical goods accounted for much of this.

Nor have all of the developments been within industry itself. The improvements in transportation, first, the new highways and the fast sailing vessels — the "clipper ships" — then the canals and steam navigation, and finally the railways, so widened markets as to bring the food

supplies of the whole world to feed the population of the industrial cities, and to provide a market for their manufactures.

As already indicated, however, large sections of the world are still to undergo their industrial revolution and change from handicraft to factory and power production. Some parts of the United States have not developed their industrial resources as fully as have the East and North. Because of differences in their natural resources, and in location, some countries and sections of countries are bound to remain dominantly agricultural, while others become dominantly industrial. But not until the industrial resources are as fully exploited as those of the soil can any region attain the levels of living of which it is capable.

TENURE

If the farmers of this country are to have the right attitude toward developments in *tenure*, that is, *rights to the use of land*, and a proper understanding of the tenure systems in other countries, and the developments in them, they need more background information than most of them now have. The usual American takes land tenure relationships as a matter of course. He knows that some farmers own the land which they operate and that some rent it, and that is about all the thought which he gives to it. He also knows that some farms are mortgaged and some not, but he assumes that the one is as much owned as the other. As for the status of the farm laborer, it does not occur to the usual person in this country that this is a form of tenure at all. Even careful students of agriculture have been known to classify farm laborers as "persons without tenure."

Individual property in land by those who really work it is a new institution, not much over two centuries old in Europe and in North America. It is still newer in most other parts of the world. The earliest prototype of modern individual property in land was the right of the family to hold a given number of acres of arable land, and to hand it down from generation to generation; also the right of the family to pasture a certain number of head of cattle or sheep on the common lands. Such rights existed in Roman times and in the early Middle Ages. In the feudal period that followed, these "freemen" as they were then called, lost their titles to their land; they had only a *right to have some land to work*, for which they must pay a rent to the manor lord and usually render some services in addition.

With the enclosures, the common fields were frequently divided, the manor lord being paid off with a certain acreage of land as a sort of

lump-sum payment, the rest going to the freemen and others who had "customary" rights in the land. Thus, individual ownership in the sense in which we use the term was able to develop. The ownership of the land came to be vested in the *individual* and not in the family as in the pre-manorial period.

However, small nominal payments in the nature of "quit rents" were for a long time made to the manor lords and their descendants. They were paid more or less in most of the American colonies south and west of New England, not to any manor lord, however, but to those who had grants of land from the crown. In many parts of South America, these crown grants are still held in certain families. It was in this way that the haciendas developed in the Western Hemisphere. Such claims were mostly wiped out in English America, however, in the settlement in 1783 following the Revolution. They have been outlawed in Quebec, but perhaps some are still collected.

The kind of property right in land which developed in the English colonies and in the United States differs in theory at least from that which still prevails in England and on the continent of Europe. We speak of our form of property right in land as ownership in "fee simple." This means that the state has no claim upon it except the general right to tax it like other property, and that the owner of it is free to dispose of it and use it in any way that he wishes so long as he does not make it into a community nuisance. If the state must have a parcel of land for some public purpose, it must condemn it, like other property, under the right of eminent domain. In Europe, on the contrary, the crown or sovereign power has never relinquished the title to the land which it held when it received tribute from the manor lords. It does not ordinarily exercise this right, but is, theoretically at least, in a clearer position to do so whenever a public need arises.[6] When the large estates were dismembered in the first stage of the Russian Revolution, the question as to who really owned the land was not settled for a time. When the Soviet government came into power, it very quickly established the state as the residual owner.

Tenancy as we now know it in this country has been in existence just about as long as individual private property. Someone had to own the land individually before the kind of a lease now in use could be given. However, the renting of land has been practiced for as far back in history as there is a record of such things. On the latifundia of ancient Rome, part of the land was frequently rented for cash. As early as 1450,

[6] In the Second World War, the British government took over and operated farms which it did not think were contributing enough food.

the manor lords began to rent some of their own lands, known as the *demesne* lands, for a cash payment. They began to prefer this system to having their farms managed for them by bailiffs using hired laborers, and when the First Enclosure Movement, usually known as the Tudor Movement and dated 1485–1600, enlarged the manor lords' demesnes, more land became available to rent to cash tenants. The Second Enclosure Movement, beginning in England around 1650, at its height in 1760–1815, and ended mostly by 1850, made still more land available for renting. More than three fourths of the farm land in England was still being operated by tenants at the time of the First World War.

Much more numerous in the Middle Ages than the cash tenants were the serfs, who had a right to live on a piece of land, but could not leave it without the manor lord's permission. The enclosure movements eventually made farm laborers of this class, or they were absorbed in the growing industry and trade of the cities. Enclosure came much later in France than in England and is still under way in parts of France. It did not begin in Germany until after 1820, and was only in its early stages in Czechoslovakia at the time of the First World War.

The renting system which developed in England is very different even today from that in the United States. It still carries a strong heritage from its feudal past. The British landlord has a different social status from the landlord in this country. The ownership of a British estate still carries much social prestige. The tenants in turn are much more strongly attached to the particular land which they operate than are ours. They commonly remain on it from generation to generation. They have security in their leases and cannot be dispossessed at the will of the landlord. They usually own a considerable share of the buildings and other improvements.

Moreover, one finds very little share renting in England. For the antecedents of share renting, one had best go to France, where, although the manor system survived longer than in England, it commonly gave way to renting under hired managers or bailiffs, and two types of tenants developed, the cash farmers, or *fermiers*, and the share farmers, called *metayers*. The manor lords supplied the metayers not only land and buildings, but workstock, seed, and machinery; and this system still prevails.

It is doubtful if in those parts of the world where access to new land has been readily available, the attitudes of the people toward tenure rights will ever be the same as in Europe. But it is also true that as the free land frontier recedes farther into the past, the attitudes will become more like those in Europe.

PRODUCTION

Although the system of farming followed in the early years of settlement nearly everywhere in the New World was that of clearing land and growing some one crop on it till it would yield no more, and then clearing or breaking another field, this was not the system which most of the colonists brought with them from Europe. England and western Europe generally had already passed from the *two-field* rotation system of letting one field rest while the other was being cropped, to the *three-field* system of winter grain, spring grain, and fallow, to *convertible field-grass husbandry*, in which hay or pasture, including in time a good deal of clover, was worked into the rotation. Then from 1780 to 1850 the *Norfolk four-year system*, including, at the start, clover, wheat, a root crop (commonly turnips), and barley, came into general use. It had to be adapted, of course, to special conditions in the different regions and countries. Eventually potatoes became the most important root crop. Corn took the place of a root crop in much of the United States.

English country gentlemen traveled much on the continent and observed the agriculture. One of them, Townshend, discovered turnips and introduced them on his estate at Norfolk. Jethro Tull found the French using a horse-drawn cultivator or "horse hoe." Out of his experiments with this he developed a system of "horse-hoeing husbandry" and published a book with that title in 1731. The main thesis of his book was that if the land was pulverized thoroughly by frequent hoeing, manure would not be necessary. He obtained larger yields, but he did not realize that he was using up the plant foods in the soil more rapidly. The drill which Tull invented came into wide use. At about the same time, Robert Bakewell developed a system of selective breeding which greatly increased the weight of his sheep and cattle and started a whole movement for improvement of breeds of livestock. Arthur Young traveled most extensively of all and wrote most effectively about it. Out of these travels and the experimenting that followed came what the English have chosen to call the "Agricultural Revolution," usually dated from 1750 to 1850.

The major revolution in agriculture, however, has come since 1850, and has been an offshoot of the Industrial Revolution. One phase of it has been the great widening of markets; another, the replacing of hand labor with machine labor and power. Landmarks in it are the cotton gin, the steel plow, the grain binder, the tractor, the truck, the milking machine, the corn picker, and now the cotton picker. Some of the most rapid progress has come with the tractor in the last few decades.

Between 1909 and 1936, the hours of labor per acre of western hard winter wheat were reduced from 6.1 to 2.2. Labor per acre of corn previous to harvest was reduced from 9 to 6 hours per acre in the same period in the Corn Belt. Corn pickers save 3 or 4 more hours per acre. The widening of markets and mechanization of production have worked together to the same ends. Larger outlets for the products of the virgin soils of new areas have made feasible the use of machinery on large fields, and the lowering of costs resulting has opened still larger outlets.

The scientific progress in agriculture in the period from 1750 to 1850 may look imposing to an Englishman. That of the ninety years since is surely more important. The foundation of a real soil science has been laid since by Liebig in Germany and by the Russians. Mendel promulgated the results of his researches in genetics in 1866, but they were not applied till much later. The science of nutrition and animal feeding has made its great strides even more recently.

In these same ninety years, there has been a further spread of crops over the earth — of corn, potatoes, citrus fruits, alfalfa, sugar beets, soybeans, etc. Commercial fertilizers have come into much more extensive use. Largely as a result of this, yields per acre of crops in Germany almost doubled in the fifty years before 1914. In general, agriculture has become more intensive, not always in the form of using more labor per acre of land, but in the form of using more capital, and a greater intensity in the actual tilth of the soil.

Another important difference between the English "Agricultural Revolution" and the one just described was that the English developments mostly pointed in the direction of a more careful husbanding of the soil; the later ones more often saved labor than soil. They therefore contributed to the exploitative systems of farming being practiced in the United States.

The early colonists brought with them from Europe a knowledge of convertible husbandry, and later emigrants the Norfolk system and the methods developed by the English "Agricultural Revolution." But, in general, they did not apply this knowledge until they had to. They tended to grow grain on the land wherever they could as long as they could. Wheat followed the frontier clear across the Corn Belt to Iowa, Wisconsin, and Minnesota. Wheat was still the dominant crop in northwestern Wisconsin as late as 1880, and in the Red River Valley of Minnesota until 1910. Wheat was followed, where the climate permitted, by corn, and corn and hogs. Even southern New England shifted strongly to corn and hogs when wheat growing moved westward. Some cattle were always kept along with the hogs, but they did not become really

important in the Corn Belt until after 1900. Fortunately the western Great Plains were too dry for crops in the beginning and ranching took possession. When cheaper systems of farming using mechanical power became available, however, even the semiarid plain lands came under the plow.

In the South, the first exploitative system of farming to attract attention was tobacco growing. The "poisoned" soils of the tobacco fields were soils that had been cropped to death. Then with the invention of the gin, cotton expanded rapidly. According to L. C. Gray, by 1850, a high proportion of Virginia and Maryland east of the Appalachian Foothills was made up of abandoned land covered with underbrush and young cedars.[7] These areas extended into much of the Southeast. Often the land was recleared and cropped again, after it had been let go for several years. In other limited sections, sugar cane, rice, and indigo were produced. Convertible husbandry has not even yet really been adopted in large sections of the South.

One reason the colonists on the Atlantic seaboard did not follow the European patterns was that the methods of cultivation, and even the particular types of plants which they brought with them, did not do well under conditions on this continent. They found themselves adopting the crops already growing here and the cultural methods of the Indians. The native systems of agriculture were almost entirely exploitative and the colonists tended to follow their patterns somewhat. But a more important reason was that more new land was always at hand.[8]

The shortcomings of individual enterprise on the land began to appear very early in America. The first land cleared began to be abandoned in New England before 1650. For a time, either by moving to other fields in the same holding, or to other lands in the same vicinity, the farmers could keep on with their exploitative methods. Also for a time, the cattle pastured on the rougher land furnished manure for the arable fields. Presently the pastures lost their fertility, however, became increasingly acid, and grew up to sweet fern, bayberry, juniper, and other weed shrubs. The early farmers of New England also cut off the trees and burned them to produce wood ashes to spread over the arable fields. By 1780 whole towns had been exploited so much that the people moved out in groups. Their first migrations were to the north. Vermont, New

[7] *History of Southern Agriculture*, Vol. II, p. 910. Carnegie Institution of Washington.

[8] One wonders, however, when looking at the stone walls of New England — the natives do not call them stone fences, because many of them are too wide for fences — whether it would not have been a great saving of labor to have, instead, maintained the fertility of the land already cleared of stones.

Hampshire, and Maine were in large part settled by farm people who moved out of southern New England. The towns in southern Vermont and New Hampshire had a rapid growth in farm population after 1800 and reached their peaks within the next fifty years; the northern counties of these states, somewhat later; Aroostook County, Maine, not until around 1910. After 1830, however, more of the migrating families moved westward along the Erie Canal and the Great Lakes waterway.

POPULATION AND FOOD

If one looks at the history of the human race from primitive agriculture to modern diversified agriculture and industry, history seems to have been a record of slow escape from hunger and starvation, rather than of growing population pressure such as Malthus predicted in his *Essay on Population* in 1798. In very large areas, and among very large population groups, disease and early death, both induced by a shortage of food more than by anything else, still combine to produce the kind of a situation that Malthus conceived. These areas have been referred to in recent discussions of the international food problem as the "Malthusian areas." Even in these territories, however, relatively fewer persons die from hunger and disease than was true a hundred or a thousand years ago. Even in India, where the average expectation of life at birth is only 27 years, as compared with 58 in the United States and 56 in Britain, and the infant mortality rate is 164 per thousand as against 55 in the United States, the great masses of the population are a little better fed than they were fifty years ago. Much more progress had been made in densely populated Japan.

What the world has seen is a contest between growth of population and improvement in the arts of production. In the Malthusian areas, the population has crowded closely upon the improvement in the arts, but usually has not quite kept up with it. In India, the population increased 15 per cent, or 50,700,000, between 1931 and 1941. This was made possible by bringing more land into cultivation, by improving the irrigation and drainage works, and by various other developments in the arts of land use and production. Out of all this increased productivity, a little was saved to improve the well-being of the masses.

In Europe, the picture is a very different one. From 1800, when the Industrial Revolution was in full swing in England, until 1930, the white Caucasian race grew in numbers from 200,000,000 to 700,000,000. The population of Europe in 1830 was 186,000,000; in 1940, 572,000,000. The rate of increase which these figures represent is close to 1 per cent

a year. It has been pointed out that if the human race had consisted of a single couple at the time of Julius Caesar, and the population had increased at the rate of 1 per cent a year, it would now be 700,000,000 people. Before 1800, apparently there were no pronounced population trends. In periods of good crops, population increased; in bad years, it decreased. There were twenty-eight famines in *Europe* between 1200 and 1600 — one every 14 years on the average. The only famine in Europe after 1900 was that of Russia in 1921. Between 1911 and 1921, however, the population of India actually declined by 1 per cent, partly as a result of the influenza epidemic of 1918–1920, which is reported to have caused the death of 12,000,000 persons. People who are underfed, particularly those who eat very little protein, succumb to mild attacks of fever.

Malthus did his writing, therefore, on the eve of very great changes in the population-food balance. Before his time, each village, manor, or town lived upon the food which it produced, or was produced near at hand. The pressure of population on the food supply forced the people to adopt systems of farming that would yield more food, with emphasis on food for direct human consumption. Livestock added to the food supply because it converted grass into human food. Sheep produced the necessary clothing, and mutton besides. When an outside market for wool developed, this brought in some cash which could be used to buy other necessities of life, but a good deal of this added income went into the coffers of the privileged classes, and if it bought food it was of a luxury kind which the peasants could not afford. When some of the villages became towns and developed handicrafts, the neighboring farms needed to produce a surplus of food for the artisans and merchants. But still most of the food produced on the farms was consumed by the farm families.

With the Industrial Revolution, however, and particularly with the improvements in transportation that accompanied it, food began moving into the industrial centers from all directions, even from different countries. The all-around increase in productivity per worker that came with the factory system provided more purchasing power for food in the cities, and for factory goods on the farms. Standards of living rose in both places. Fully as important, the cities were able to absorb the surplus population of the farms. With factory output still expanding, and agriculture producing more food and textiles, the populations are still increasing. In the fifty years from 1880 to 1930, the population of the different continents increased at the following rates per thousand annually:

Europe	7.8
Asia	4.8
Africa	0.3
North America	15.6
South America	26.3
Oceania	16.8

Malthus would surely have been amazed at these figures. He would be even more amazed at the present outlook for population increase in Europe as presented recently by the population research group at Princeton University. These indicate a declining rate of increase for Europe as a whole, not because food is proving inadquate, but because of the operation of the "moral restraints" in which he lacked confidence. For Europe, exclusive of Russia, the Princeton group forecasts a maximum of 421,000,000 in 1960–1965 and thereafter a decline. The population of Russia will increase for a longer period because the effects of the Russian Industrial Revolution upon population growth will still be in evidence until sometime after the year 2000. Most of the countries of southeastern Europe will also continue to grow after 1965. For Europe including Russia, the Princeton group predicts an increase of only 7,000,000 from 1965 to 1970 as compared with 21,000,000 in the five years just ahead.

An industrial revolution goes forward much more easily in a country which is not overpopulated. One of the good fortunes of the United States is that its Industrial Revolution came while the soil and other natural resources were still abundant. The capital needed to finance the Industrial Revolution and the mechanization of agriculture was easy to provide out of current income. In a densely populated country like China, nothing is left over at the end of the year, and capital accumulates very slowly. Outside capital has often come into countries of this sort and assisted very greatly in making the transition. British capital, in fact, helped greatly in the early history of the United States. British and American capital have been helping Canada in this way. The Latin American countries, for the most part, reached a stage of rather high population pressure before they began to industrialize. The native populations were already practicing, in a good part of this territory, a type of settled village agriculture which was not highly productive. These populations have continued to multiply and have mixed freely with the invading peoples. Although natural resources are very great in much of Latin America, capital accumulation is very slow.

In the Far Eastern countries where industrialization has not yet occurred, some 70 to 80 per cent of the families live on the land. The

heads of most of these families are farmers, although a number are farm laborers working for the larger farmers. Roughly two thirds of the world's population spend their lives producing foods and fibers. The contrast between the countries in the percentage of working population engaged in agriculture is shown in Table 7. The proportion of the population engaged in agriculture depends upon the birth and death rates, the number of nonfarm job opportunities available to the people, and to some extent on the emigration policies of the country. Farm families the world over produce an excess of children over those needed for replacements; and everywhere the situation is much the same, the boys are born into the agricultural occupation, and having no other occupational experience, shift slowly into nonfarm work.

TABLE 7. PROPORTION OF POPULATION IN AGRICULTURE

Country	*Census Year*	*Percentage of Working Population in Agriculture*
United Kingdom	1931	5.7
United States	1940	18.5
Switzerland	1930	20.1
Netherlands	1930	20.6
Germany	1933	28.9
Austria	1934	26.0
Denmark	1930	30.3
Norway	1930	31.0
Czechoslovakia	1930	34.2
France	1931	34.5
Hungary	1930	50.8
Poland	1921	72.3
Bulgaria	1926	80.0
U.S.S.R.	1926	83.2

Source: D. Warriner, *Economics of Peasant Farming*, New York, Oxford University Press, 1939, p. 20.

There is therefore little point in talking about the population and food supply of the earth as a whole. A statement such as that recently made by Professor Karl Sax, that two and one half acres of arable land are needed per capita of the population, and at present only two acres are available, has no meaning whatever.[9] Already a large part of Europe, and an even larger fraction of the New World, has adjusted its population to its resources in such a way that the arts are improving faster than the population is growing, and an approach is being made to the

[9] Karl Sax, "Population Problems of a New World Order," *The Scientific Monthly*, January, 1944, p. 66

optimum ratio of the population to the land — that is, the ratio which, at any given state of the arts, affords to the average person or family in the country the food and clothing, and levels of living in general, which is best for the welfare of the group. Other countries of Europe will make such an adjustment presently, and within the next century no doubt all of Europe. It will take them much longer than this to reach the state of the optimum, but they will all be headed in that direction before long. In Russia today, although the population is still increasing rapidly, the arts are improving more rapidly. Asia will in time begin to follow the same path, but it will be a more difficult one. The prospects in Latin America vary greatly by individual countries, but all will reach a turn in the road someday.

Hunger and starvation as Malthus conceived them therefore pose no greater threat to the peace of mankind in the future than in the past. In fact, the prospect is the other way, once the wreckage of the war is cleared away. The major factor in the population-food balance of the future is posed by the data in Table 8. It is, for any country, how large a fraction of the elements required for an adequate diet will come from cereals, dry beans and peas, and potatoes and other products for direct human consumption that yield a large return of calories, proteins, minerals, and vitamins per acre and per day of labor, and how much from animal and other low-yielding sources. The people already with a low ratio of population to land resources will tend to shift further toward animal products and more fruits and vegetables. Those with a high ratio of population to land resources will begin to shift in the same directions, but slowly at first, whenever the improvements in their arts of production begin to gain on their populations. For much of the Western world, the prospect is for a strong drift in this direction in the next fifty years.

The several preceding sections have presented us with a picture of a national agriculture going forward from year to year, decade to decade, and century to century, in a world of complex change, some of it taking the form of sharp breaks and quickly alternating cycles of supply, demand, and prices, some the form of longer cycles or short trends, and some the form of sweeps and trends seemingly without end. These longer sweeps may involve the whole organization of society and its land tenure systems, the organization and techniques of production, and the relation of population growth and diets to food supply.

And there is no reason to believe that the patterns of change will become any simpler in the future than now, or that the rates of change will slacken. Instead, a more reasonable hypothesis is the contrary of

TABLE 8. FOOD VALUES PER ACRE AND PER DAY FROM A SAMPLE LIST OF FOOD PRODUCTS

	Energy 1000 CALORIES		*Proteins* POUNDS		*Fats* POUNDS		*Minerals* YEAR'S SUPPLY[a]		*Vitamins* YEAR'S SUPPLY[a]	
	Per acre	*Per day*	*Per acre*	*Per day*	*Per acre*	*Per day*	*Per acre*	*Per day*	*Per acre*	*Per day*
A. FOODS FOR DIRECT HUMAN CONSUMPTION										
Wheat — white flour	835	740	56	50	5	4	1.0	0.9	0.16	0.14
Corn — yellow corn meal	1880	550	96	28	14	4	0.8	0.2	0.64	0.19
Rice — white	2135	535	102	25	4	1	1.9	0.5	0.35	0.09
Potatoes — white	2285	270	118	14	8	1	7.4	0.9	4.45	0.52
Potatoes — sweet	1805	130	55	4	22	2	5.0	0.4	10.58	0.74
Sugar beets — white sugar	6250	545	0	0	0	0	0.0	0.0	0.0	0.0
Beans — dry, edible	1080	335	150	46	10	3	10.7	3.3	1.08	0.33
Peas — dry, edible	1250	....	190	?	8	?	7.6	?	2.15	?
Soybeans — whole, edible	1545	1030	340	226	176	117	15.2	10.2	2.53	1.68
Carrots	2685	66	166	4.0	47	1.2	7.2	0.18	58.9	1.46
Cabbage	870	64	96	7.0	11	0.2	3.2	0.23	15.9	1.17
Onions	2227	69	138	4.0	20	0.6	4.2	0.13	5.6	0.17
Beans — snap, fresh	372	24	48	3.0	4	0.3	1.5	0.10	1.3	0.21
Tomatoes — fresh	408	19	41	1.9	13	0.6	1.3	0.06	7.4	0.21
Spinach	252	18	52	3.6	6	0.4	2.6	0.18	15.6	1.09
Oranges	1909	98	68	3.5	12	0.6	2.7	0.14	15.9	0.82
Peaches	939	60	18	1.1	5	0.3	1.1	0.07	5.8	0.37
Prunes	2582	180	44	3.1	11	0.8	3.4	0.24	2.5	0.18
Apples	1073	70	13	0.8	16	1.0	0.6	0.04	1.4	0.09
B. FOODS OF ANIMAL ORIGIN										
Milk — whole	350	65	39	7.1	44	7.9	0.89	0.17	0.48	0.14
Butter	190	35	2	0.1	46	8.3	0.01	0.0	0.10	0.03
Cheese — American	205	35	27	4.9	37	6.6	0.65	0.12	0.16	0.05
Dairy products	290	50	25	4.4	45	8.1	0.58	0.10	0.30	0.09
Eggs	145	25	26	4.5	23	4.0	0.33	0.06	0.28	0.08
Broilers	110	20	27	5.1	17	3.2	0.16	0.03	0.18	0.06
Hogs	500	30	18	4.6	115	29.8	0.16	0.04	0.53	0.23
Beef cattle	45	25	7	3.6	8	4.4	0.05	0.03	0.07	0.06

Source: Adapted from Tables 1, 2, and 3 of Chapter 12 of *Food Enough* by John D. Black, Jacques Cattell Press, Lancaster, Pa., 1943. The estimates used in these tables are those made by Raymond P. Christensen of the Bureau of Agricultural Economics.

[a] A year's supply for one person.

this. The science of farm management consists in the main of a set of principles having to do with adjustments to meet these changes, and methods of making these adjustments. PART TWO of this book undertakes to introduce these principles to the reader in terms of their applica-

tion to the major systems of farming in the United States, beginning with simple one-crop farming, and ending with two chapters dealing with diversified crop-and-livestock farming. In these chapters, *farms will be studied as organic wholes, not cut up into segments.* While there is an abundance of analysis of particular lines of production in this book, the major portion of this material is contained in special chapters dealing with particular types of farming such as cotton farming, dairy farming, and poultry farming, in PART FIVE. PART THREE undertakes to integrate the major principles into a balanced system of thought; and PART FOUR to explore some of the special problems of farm management.

FURTHER READING

* "Farmers in a Changing World," *1940 Yearbook of Agriculture*, "Summary" by Gove Hambidge, and Part I especially.

N. S. B. Gras, *Agriculture in Europe and America*, New York, F. S. Crofts and Company, 1925.

John D. Black, *Food Enough*, Jacques Cattell Press, Lancaster, Pa., 1943.

* *Agricultural Outlook Charts*, Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C.

EXERCISES

1. Which of the farm products of your state are exported? Which are imported in part?
2. Study the charts in the latest annual edition of *Agricultural Outlook Charts* and decide which commodities seem to have exhibited cyclical price movements and which trends.
3. Describe, in as quantitative terms as possible, the shifts in agricultural production which have occurred in your state or in some local area with which you are familiar, since settlement by white men.
4. Prepare a brief report reviewing the changes, other than mechanization and electrification, which occurred between World Wars I and II, affecting farm production in your home area.
5. What changes do you expect to see in the next twenty years in the general organization of agriculture in your home county? Why? How can farmers best be prepared to meet them?
6. Construct a table of foods listed in Table 8 for direct human consumption that will provide a year's supply for one person from the least possible land, allowing 2,500 calories per day, 50 pounds per year of proteins, and 75 pounds per year of fats. Then construct one which uses foods of animal origin for at least half the calories. Compare the two tables.

Part Two

SYSTEMS OF FARMING

CHAPTER VII

The Management of One-Crop Farms[1]

WE ARE READY NOW TO SETTLE DOWN TO A CAREFUL CONSIDERATION of the actual management problems of different systems of farming. It is best to do this one system at a time, and to take the simpler ones first. From the standpoint of the management principles involved, the simplest farms are those which produce one crop and sell it for cash. Next come those which produce one livestock product and buy all the feed. Then come the crop farms with two or more crops; then the livestock farms producing much of the feed used; then the most diversified of all systems of farming, those which sell both crop and livestock products. As we proceed from the simpler to the more complex systems of farming, the farm management principles involved will appear one after the other in order; and each will have been studied, not as an abstraction, but in actual use. This and the following chapter deal with the management problems of one-crop farms, and introduce only principles which apply to such farms. Four types of one-crop farms are considered in detail: potato farms in Aroostook County, Maine, flue-cured tobacco farms in North Carolina and Virginia, cotton farms in the Black Prairie of Texas, and wheat farms in the wheat areas of Washington and adjacent Oregon.

The best way to find systems of farming in the United States is on the map of "Type-of-Farming Areas" prepared by Dr. F. F. Elliott in connection with the 1930 census and published as part of the census report *Types of Farming in the United States*. At the same time that the census classified the farms of the United States by types of farming, it mapped all of the country into 514 type-of-farming areas, beginning with No. 1, a poultry and dairy area on the shores of the Puget Sound in the state of Washington, and ending with No. 514, the Cape Cod cranberry area of Massachusetts. Many of these type-of-farming areas

[1] The information in this chapter is based largely on Maine Bulletins 378, 390, 406, 424, and 432 by William E. Schrumpf. Supplementary information was supplied by William E. Schrumpf, Charles H. Merchant, and Joseph Chucka of the Maine Agricultural Experiment Station. The authors are entirely responsible for the analysis and use made of the information in this chapter.

were broken down into subtypes A, B, etc. *A type-of-farming area can be defined as all the territory within which a particular product or combination of products is found on most of the farms; or within which the same systems or types of farming are found intermingled.*[2] The second part of the definition fits areas like those in the second zone out from large cities in which dairy, poultry, and vegetable farms are often found on the same highway.

Except for the influence of markets, the boundary lines between these type-of-farming areas tend to follow natural differences of soil, topography, and climate. Thus, as one goes west in northern Minnesota from the formerly wooded and lake region known as the "Park Region" into the leveler lands of the Red River Valley, the types of farming change from dominantly dairy to a combination of potatoes or sugar beets with more grain and much less dairying.

The census did not repeat this mapping of farms into areas in 1940, but the changes in the boundaries of such areas are rarely important within ten years. The 1930 map shows 47 areas and subareas in which most of the farms are single-crop farms, that is, with 40 per cent or more of their income from one crop. Eight of these are in California, 5 of which produce fruit and 1 each, lima beans, cotton, and alfalfa. Across the line in Arizona are 2 more cotton areas. All of these are small areas. The 8 areas in California cover not more than 8 per cent of the area of the state. Covering much more area than all these combined, is the big Columbia Basin wheat area with 6 subareas scattered around eastern Oregon and Washington and across the line into Idaho. Washington and Oregon have in addition 5 small orchard areas, a potato subarea, and 2 small isolated wheat areas. The rest of the West, making up the Rocky Mountain region, has only 7 one-crop areas, and 4 of these are small irrigated subareas growing cotton. The other 3 grow sugar beets, beans, and fruit.

The next big block of one-crop areas, including 14 of them, is in the South, and all grow cotton except the Louisiana sugar-cane area, the Arkansas rice area, the North Carolina-Virginia tobacco area, the Virginia peanut area, the Louisiana strawberry area, and the potato and celery areas of Florida. All combined, however, these 14 areas cover not more than a fourth of what is ordinarily called the Cotton South.

[2] The term "combination" takes account not only of which products are combined, but also the proportions in which they are combined. A "dairy-tobacco" system of farming is understood as one dependent more largely on dairying than upon tobacco; and a "tobacco-dairy" farm the reverse of this.

The terms "system of farming" and "type of farming" are used more or less interchangeably in this book. In general, however, system of farming is the broader term. The census based its classification of types of farming particularly on the share of the gross income of the farms obtained from different sources. See p. 45.

Elsewhere in the South, a large fraction of the farms obtain less than 40 per cent of their incomes from cotton.

The only other one-crop areas in the United States are the Maryland tobacco area, the tiny mushroom area in Chester County, Pennsylvania, and the Aroostook potato area. There are other areas famed for particular products — in Kentucky for burley tobacco, in Massachusetts for cranberries, in Wisconsin and Idaho for potatoes, in Colorado for Rocky Ford cantaloupes, in Washington for blackberries — but either the product is grown only on part of the farms, or represents less than 40 per cent of their income. Then, too, many thousands of one-crop farms are scattered here and there through the more diversified farming areas — perhaps isolated wheat farms in areas where wheat and livestock are usually combined on the same farm, or tobacco or potato farms in areas where most of the farms combine these with dairying.

AROOSTOOK POTATO FARMING

Practically all of the agriculture of Aroostook County is in 31 of its 186 towns lying next to its eastern Canadian border, and most of it is in 20 of them. The rest of the county is timberland, spruce being the most important species. The soil in the forest is relatively thin, lying over the hard ancient rocks of the Laurentian highlands. The land now used for potatoes, however, once supported a strong growth of red pine, and is mostly free of large rock, and has gently rolling to level topography. The big pine logs were floated down the St. John River, and its tributary, the Aroostook, to St. John in New Brunswick. Part of the potato area is on the Canadian side of the river. (See chart 22.)

Soil and climate and nearness to big city populations account for the high degree of specialization in potatoes in Aroostook. The wealth in the Aroostook soils is not in any inherent abundance of plant nutrients, as in the prairie soils of the Corn Belt, but in their structure. They do not look like rich soils, and are not. They are yellowish-brown on the surface, and were derived from the weathering of calcareous shales. They have a low content of clay, and a high content of shale fragments. They have a loose mellow structure and good internal drainage and aeration, and can be cultivated easily and soon after rains. Yet they have a fairly high water-holding capacity and can stand spells of moderately dry weather. These, however, occur infrequently. The average rainfall for the four growing months, June to September inclusive, is twelve to eighteen inches. The July temperature mean is 65° F., and the winter snows are heavy.

The lumbering operations were at their height in this area around the middle of the last century. The first agriculture was developed to provide hay, oats, and local food products for the lumber camps. An "exploration and survey of the territory of Aroostook" in 1838 reported that "the staple crop is, and must ever be, wheat." It pointed out, however, that the area was well suited to the growing of "culinary roots." The lumbermen no doubt consumed a good many of these culinary roots, but not as many as the area would have grown if it had had a market outlet. As late as 1881, the county had only sixty miles of railway. The Bangor and Aroostook Railroad reached Caribou in the heart of the area only in 1895. The acreage of potatoes in Aroostook County was 14,000 in 1880, 42,000 in 1900, 75,700 in 1910, and 162,400 in 1930. It then leveled off at around 140,000 acres till the war demand pushed it up to 172,000 in 1943. In the rest of Maine, the potato acreage dropped from 60,000 to 30,000 acres between 1910 and 1920, at which level it remained until 1940.

Until 1930, Aroostook was still an expanding frontier. While the main frontier was pushing westward to the last possible stretch of land that could be dry-farmed, a bit of it that had been left behind was pushing into the northeastern corner of the country. The journalist Charles Morrow Wilson, in his book *Aroostook, Our Last Frontier*, portrays the people of the area as having the same venturesomeness, the same faith in the future, and much of the same carelessness about providing for that future which usually accompanies such a faith, that has characterized the generations moving westward. There has also been the same dependence on a commercial market and on long-distance transportation. Aroostook may not seem far from New York City, which it supplied with half of its potatoes until 1933, but the rail freight is 47 cents per hundredweight. To Boston, it is 37 cents.

THE FARMS How almost completely specialized Aroostook farming is may be judged from the fact that all but 15 per cent of its farms reported in 1930 and again in 1940 were classified as potato farms, and most of the remainder were "self-sufficing" farms or the like. Crop sales on the 5,600 potato farms reported in 1930 averaged $6,160, nearly all from potatoes. Livestock receipts averaged $250. These farms kept only 2.0 cows for milk and two hogs or pigs. The number of horses had fallen off to two per farm in 1940, nearly half of the farms having tractors. The average investment in 1930 was $11,400 in the farm and $1,840 in machinery. The average potato farm had 141 acres, of which 65 acres were in crops, 14 in pasture, and the rest in woodland and waste.

Interspersed with the broad fields shown in the Figure are many poorly drained patches of muck, or of two soil types intermediate between the main soil type, Caribou loam, and the muck. These patches make up 35 per cent of the land surface, and the Caribou loam 60 per cent. The remainder is gravelly and stony land. The poorly drained soils if cleared are mostly used in pasture, hay and oats rotations.

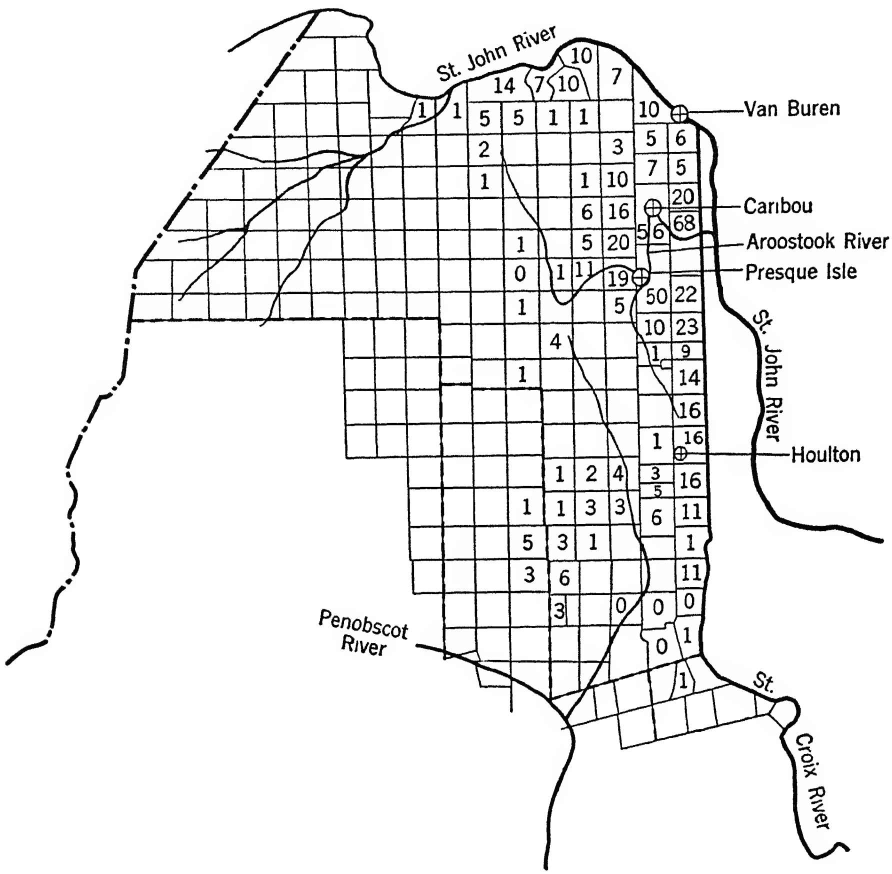

CHART 22. The potato-growing area of Aroostook County, Maine. The high concentration of production is due largely to soils and topography.

The foregoing averages are for the thirty-one towns. In the St. John Valley at the northern end, and also to the south, the farms are somewhat more diversified than in the heart of the area around Presque Isle. Many of the families in the St. John Valley are French in origin, descended from the people that Longfellow wrote about in his *Evangeline*. Many of these families formerly depended for part of their income on

labor off the farm — mostly cutting pulpwood. The pulpwood within reach of their homes has nearly all been cut. Also in the town of New Sweden on the western edge of the area, a group of Swedish settlers have developed a system of farming combining dairying with potatoes.

METHODS OF CULTURE Most of the potato farms in Aroostook County follow a rotation system built on potatoes, oats, and clover or clover-timothy. A few combine a green-manure crop of oats and field peas with potatoes. A very few grow potatoes on the same land continuously. Those using the oats and clover system may grow potatoes two years in succession, or only once. The clover and timothy may be used for hay either one or two years before it is plowed under. The plowing under is usually done in the fall. The rotation may, therefore, run from two to five years, and the fraction of the potato land in potatoes from a half to a fifth.

A distinction needs to be made between the farms which produce eating or table-stock potatoes, and the much smaller number which produce certified-seed potatoes, either for use by other farmers in the area or for shipment to southern growers. Irish Cobbler and Spalding Rose are the varieties mostly grown for the southern trade. The certified-seed farms are highly specialized.

Most table-stock potatoes produced in Aroostook County are of one variety, the Green Mountain, or of some of the new hybrids of Green Mountain, like Katahdin, Chippewa, Houma, and Sebago which have been bred for resistance to mild mosaic, late blight, or net necrosis. The leading early variety is Irish Cobbler. The careful growers use certified seed wholly or in alternate years, and treat the seed for scab and black scurf. They spray for late blight about every two weeks with Bordeaux mixture. In planting, the seed is dropped on top of the ground and then covered with disk shovels to a depth of four inches. It is usually hilled up twice after that, to produce a ridge twelve to fifteen inches high. The barnyard manure available covers only 14 per cent of the potato crop. The most common commercial fertilizer application before the war was a ton per acre of a 5–8–12 formula. The green-manure crop is usually field peas, mammoth clover or crimson clover. At first, the growers had difficulty in establishing clover stands. Their soils were too acid. They now apply enough lime with the clover to keep the pH not over 5.2. If it goes above this, the potatoes become scabby. Dolomitic lime is now used because magnesium deficiency appeared in many of the fields. The continuous-elevator type of potato digger is replacing the shaker type — it bruises fewer potatoes. The potatoes are hauled

OPERATING STATEMENT

FOR THE YEAR ENDING *March 31, 1939*

Receipts			
Potatoes sold[a] — 13,950 bu. at 62¢		$8,650	
Oats sold — 490 bu. at 52¢		253	
Livestock sold — cow, calf		62	
Eggs sold		20	
Miscellaneous		60	
Total receipts			$9,045
Inventory			
Livestock			
March 31, 1938	$ 600		
March 31, 1939	575		
Gain or loss		− 25	
Farm buildings and equipment			
March 31, 1938	8,300		
March 31, 1939	7,840		
Gain or loss		− 460	
Feed and supplies, including seed potatoes			
March 31, 1938	800		
March 31, 1939	620		
Gain or loss		− 180	
Potatoes on hand			
March 31, 1938 (1,800 bu.)	1,110		
March 31, 1939 (2,200 bu.)	1,364		
Gain or loss		+ 254	
Total inventory gain or loss			− 411
Expenses			
Labor			
Hired by the month, wages plus cash outlay on board, etc. 15 mos. at $55	$825		
Cutting seed, 375 bbl. at 30¢	112		
Picking potatoes, 5,500 bbl. at 7¢	385		
Threshing	80		
Total labor		$1,402	
Fertilizer[b] — 1 ton per acre of 5–8–12 on 45 acres at $40 per ton		1,800	
Seed[c]			
Certified potato seed, 22 bu. on 25 acres at $1.20 per bushel	660		
Clover and grass seed — 900 lb. at 22¢	198		
Total seed		858	
Spray materials, etc.			
Arsenate of lead — 400 lb. at 12¢	48		
Copper sulphate — 2,400 lb. at 7¢	168		
Lime — 2,000 lb. at 1¢	20		
Materials for seed treatment at 60¢ per acre	30		
Total sprays, etc.		266	

Storage — 1,800 bbl. at 12¢		216		
Barrels, boxes, sacks, twine, etc.		118		
Gasoline, oil, grease		206		
Feed — 1.4 ton at $40		56		
Miscellaneous livestock expense — (Veterinary, horseshoeing, breeding fees, 3 pigs, etc.)		52		
Repairs and servicing				
Buildings	80			
Machinery	170			
Total repairs		250		
Insurance		70		
Taxes		400		
Miscellaneous — telephone, etc.		90		
Total expenses			$5,782	
Net Business Gain or Loss				$2,852

[a] Total production at harvest was 15,650 bushels, but 540 bushels were used for seed, 450 bushels of culls were fed to livestock or wasted, 40 bushels were used by the farm family, 400 bushels represent an addition to inventory, and the remainder was shrinkage in storage.
[b] Barnyard manure was used on five acres.
[c] Half the seed was from stock specially grown on the farm.

This family, therefore, had $2,852 left after paying all of its out-of-pocket expenses on the farm business, putting $460 in a reserve, as it were, to cover the depreciation on buildings and equipment, and allowing for changes in inventory of potatoes, seed, supplies, and livestock. This is compensation for the labor and management of the farm operator, for the labor of the family on the farm, and for the labor of the family in boarding and lodging the hired help, plus the return on the investment. The family also had the use of the farmhouse, and produce from the farm, gardens, and poultry.

Although this operating statement is presented as of the crop year 1939, the prices used are the average for the 1935–1939 years, and the yield of potatoes, 313 bushels, is the average for these years on the farms following this rotation system and using this same amount of this fertilizer formula. In any one year, the receipts might be very different. In 1937, for example, the yield on such farms was 350 bushels, but the price was only 34 cents a bushel, since the crop was unusually good also in other late-crop areas. In 1936, the yield was also 350 bushels, but the price was 89 cents because of a poor crop in other important areas. The value of the crop was $120 per acre in 1937 and $310 in 1936. In 1938, the yield was down to 250 bushels and the price only 52 cents. Thus, the growers had poor returns in both 1937 and 1938. Obviously a potato grower cannot plan his production on the basis of the yields and production of any one year or two, and certainly not on those of the preceding year.

ALTERNATIVE CROPPING SYSTEMS Let us now consider a few of the alternatives which the manager of this farm has. First comes the choice of cropping system. The 100 acres in the present potato rotation, which we shall call A, could easily be changed to any one of the following cropping systems:

B. Only potatoes and a green-manure crop of oats and peas, or of crimson clover, with 50 acres in potatoes. No oats or hay would be harvested on the 100 acres, and an all-purpose tractor would be used. The 6 acres of oats and 12 acres of hay in the other rotation would be used for the cattle, pigs, and chickens, but a little grain would have to be purchased.
C. Potatoes year after year on the whole 100 acres of potato land.
D. A five-year rotation of potatoes two years, oats, and hay two years on all of the 100 acres, the hay being harvested the first year and enough cattle kept to consume the hay and oats. This would reduce the potatoes to 40 acres.
E. The hay can be cut both years and more livestock kept.
F. A three-year rotation of potatoes, oats, and clover and timothy hay, the first crop of hay being cut, and the aftermath being plowed under. This would confine the potatoes to 33 acres each year, and increase the feed for horses and livestock.

It is not impractical to consider any one of these alternatives. All five are now being followed even in the central portion of the potato area, although not many are following Systems C or F. A survey just before the war showed that in the Presque Isle section 38 per cent of the cropland was in potatoes, 28 per cent in clover and timothy, 19 per cent in small grain, and 11 per cent in green-manure crops. This indicates either that many were following Systems D and E, or even System F, or that many of the farms had considerable cropland not suited to potatoes. During the war years, however, many farms shifted to Systems B and C.

If the farm we are now analyzing were to shift to System B, the operating statement would be changed as follows:

1. The yields would be raised 12 per cent, from 313 to 350 bushels per acre, if we take as a guide the results of eleven years of plot experiments conducted by the Maine Experiment Station.[3] This would increase the production of potatoes to 17,500, and the receipts from sales of potatoes to 15,900 bushels at 62 cents or $9,858.
2. There would be no sales of oats and hay.

[3] J. A Chucka, Arthur Hawkins, and B. E. Brown, *Potato Fertilizer — Rotation Studies on Aroostook Farms, 1927–41*. Bull. 414, 1943.

3. Receipts would be $812 larger, after balancing increases against decreases.
4. The labor expense would be increased $130 for picking, but $80 would be saved in threshing. The same regular force would do the work, and would not be as fully employed as before since there would be less hay and oats to handle. Additional labor cost, $50.
5. Additional supplies totaling $385, consisting of: fertilizer (less barnyard manure), $125; seed (peas, etc.), $60; containers, $20; feed, $120; gasoline, etc., $60.
6. Other additions to expense: storage, $40; machinery repairs and servicing, $80; insurance, taxes, miscellaneous, $15. Total $135.
7. Miscellaneous livestock expenses reduced $35.
8. Total increase in expenditures, $535.
9. Inventory changes: machinery inventory increased $1,100; livestock reduced $300. Depreciation increased $60.
10. Net profit increased by the difference between $814 and $535 + $60, which is $220.

Before a final decision to shift to this system is made, however, other factors would need to be considered. One of them is the long-time effect on the soil. One cannot be sure whether plowing under this much green manure will add anything further to the soil after ten years or so. Another factor is that without a horse to cultivate a garden, the family may not have as good a garden. Or some of the growers will keep one horse so as to have it available for the garden work and little odd jobs, and some even keep a team after shifting to the B rotation, preferring to use horses for some of the minor operations. In this case, the gain will be something less than the $220.

The experimental results with potatoes grown every year under System C indicate yields on this farm of 300 bushels per acre, 14 per cent lower than with System B, and 4 per cent lower than with System A. A detailed comparison of additional receipts and expenses such as just presented for the shift to B, would show $7,360 more receipts than from System A, and $5,740 additional expenses. Larger storage would be needed, and the mechanical equipment would include an additional all-purpose tractor, an additional two-ton truck, additional plows and harrows, and more or larger spraying and harvesting equipment. This would represent an additional inventory of $2,000. The additional supplies for operating the equipment would cost $180, and repairs and depreciation would be increased by $290. The regular labor force on the farm would consist of two year-round hired men, and fourteen months of additional help would be needed by the month or day. At the wage

levels prevailing in 1935–1939, this would call for an increased expenditure of $1,265. The piecework labor would cost $460 more, and the fertilizer, sprays, and other supplies $3,130 more. Taxes, insurance, and miscellaneous would be $90 more. The net profit would appear to be increased by $1,620.

However, the longer run is highly important in this case. The effect on the structure and water-holding capacity of the soil of continuous cropping with a cultivated crop is cumulative until the humus is all burned out, and it takes more than the twelve years that these experiments ran to reach this point. Erosion becomes an important factor also, especially on sloping fields, since satisfactory winter cover crops are not available this far north. Contour cultivation will help greatly, but will not give protection enough.

Both with this shift and the shift to System B, the character of the land on the particular farm, and its condition of fertility and texture at the time of the shift, will go far toward determining the short-run and long-run advantage of the shift. Experimental results on plots can be taken only as general guides. Each farm needs data of its own by individual fields. Not until from five to ten years of field records are available for his farm will a farmer be able to do a good job of adjusting experimental results to fit his farm.

The farmer will be the deciding factor in more cases, however, than will the land. Some will not be able to make Systems B or C work well, at least not until after five or ten years of trial and error with them. On the experimental plots, each operation was performed at the right time. This is particularly important with the spraying. When the experimental plots did not get their late blight spray till a week late at a critical point in 1938, the yields were reduced on all the rotation plots, and Systems B and C yielded almost alike. In 1941, systematic dusting with rotenone for aphids caused all the yields to run high, and to be very similar on all the rotation plots. In earlier years before the growers had learned to spray for blight as systematically as now, average rainfall in July gave better crops than relatively heavy rainfall because it reduced the growth of the potato vines and hence susceptibility to blight.[4]

A consequence of the foregoing is that yields under actual farming conditions do not run as high as those on experimental plots. The average yields on the experimental plots in the rotation trials were from 351 to 404 bushels per acre, compared with 325 bushels on the better farms in the area, and under 300 on the usual run of farms.

[4] F. V. Waugh found that the August 1 crop reports on the condition of the crop, based largely on vine growth, had been inversely correlated with subsequent yields.

We will not undertake at this point to analyze the effect of shifting from the A to the D, E, and F cropping systems because these involve the expansion of livestock production as a way of disposing advantageously of the additional oats and hay, and we will not be ready for analysis of such a shift to livestock until we reach Chapter XIII. Suffice to say that they generally show lower net incomes per farm. Nevertheless, they persist in Aroostook County, even in the Presque Isle section of it. No doubt a major reason for this is management. System F is more in keeping with traditional farming methods — it keeps the land under cover two years out of three, and probably requires less detailed attention. Type of land is a further reason — the cropland classed as second-grade in the recent survey of the thirty-one potato townships averaged one third in potatoes, the same as under this system. The experimental plots following System F had yields intermediate between those following Systems B and C. But these plots were on first-grade land under careful management.

EFFECT OF CHANGES IN PRICES, WAGES, ETC. These analyses show the relative profitableness of the different systems with potatoes at 62 cents a bushel, fertilizer at $40 a ton, labor at $55 a month, etc. A change in any one of these, particularly a change in the price of potatoes, would change the relative profitableness of the different systems. The system that produces the most potatoes has a higher advantage with potatoes at 89 cents a bushel as in 1936, than with potatoes at 62 cents a bushel. At 34 cents a bushel as in 1937, all systems lose money, but not equally — since each bushel of potatoes produced is sold at a loss, there is no object in producing more bushels.

Since a farmer does not usually know in advance of planting what his selling price is going to be, all he can do is to exercise his best judgment about it. Because potato yields and prices fluctuate over such a wide range, a rule commonly followed in potato-producing regions is to take the *average price* over a series of years. This is much safer than using the price of the preceding year, but still far from satisfactory. It may, for example, include several years of depression, such as 1931–1934 when potato prices in Aroostook County averaged only 31 cents, or it may include several war years like 1941–1945. Also, as explained in Chapter VI, potato prices may be trending upward or downward as a result of a general shifting of demand, or of improvements in techniques of production which reduce the cost. The average must therefore be adjusted for these circumstances. Finally, the particular year for which one is planning may be a year in a depression, or in a period of high

prices; or it may be affected by other special circumstances. The farmer, therefore, must be in a position to judge the price outlook. This subject of judging prices will receive special consideration in Chapter XX.

BUDGET ANALYSIS Once having determined what is a reasonable price for fertilizer, labor, seed, grain, and other materials used in production, and reasonable yields to expect, a farm operator can work out, for any cropping system which he is considering, an operating statement like that presented for System A above. A statement of this kind prepared in advance of the year's operation is known in business as a *budget.* Good business management always proceeds on the basis of a budget of anticipated receipts and expenses made out in advance of the business year. The various departments of the business then know what their allotment is and are expected to keep within it. They also know what they are expected to accomplish in the way of output and do their best to measure up to the goals set. Public business similarly operates on the budget basis, and family financing as practiced by careful housekeepers.

Of course nothing is ever final about a budget. The experience of operating under a budget for a year is likely to show that some of the items are too high or too low. Prices and wages and other cost-rates, and methods of operation, change so much that budgets are always in more or less a state of flux. But if they are carefully made and analyzed, each year they become better and better guides to management.

Budget analysis, however, should not stop with setting down in advance the receipts and expenditures and estimating the profit and loss from one system of operation. *It should undertake to determine in advance how the profit or loss differs if each of several different systems of operation is followed. It should carry such analysis to the point that the farmer is satisfied in his own mind as to which of the alternative systems of operation will prove most profitable.*

Such determinations do not ordinarily need to be made all over again each year. They should indicate in advance which system is likely to prove most profitable on the particular farm under the conditions likely to prevail *within the next five or ten years.* Clearly a potato farm cannot shift from A to B or to C from year to year and back again. The operator needs to make up his mind what prices for his produce, materials, and equipment, and what wages for hired labor, are likely to prevail in the next five or ten years, what yields he is likely to get from the different systems, and on the basis of these, decide which system promises most over this period. Then he needs to watch developments in demand, prices, cost-rates, and technology; and when he

decides that basic changes are in the making that will affect the relative profitableness of different systems, do a thorough job of rebudgeting the different alternatives and prepare to change his system without delay if it needs it.

One other important consideration can only be mentioned at this time — fuller discussion is reserved for Chapter XX. Clearly, if a shift to System B which increases the output of his farm from 15,650 bushels to 17,500 bushels, is best for his farm, it will be best for many other farms in Aroostook County, and probably in some competing regions also. As soon, however, as any considerable number of growers have shifted, the supply will be increased relative to demand, and prices will be less than 62 cents a bushel. The budgeting will therefore need to be redone on some lower level of prices.

ALTERNATIVE RATES OF USE OF FERTILIZER The next important set of alternatives has to do with the rate of use of fertilizer, labor, spray, seed, and other input factors. The simplest case to analyze is that of fertilizer. Although the average application in the area before the war was a ton of 5–8–12 formula, the range was from a half ton to one and one half tons.[5] The problem for the manager is what amount pays best on his particular farm. This is a familiar problem in input-output relations. The economic principle involved is the familiar principle of diminishing returns, which states that as more units of a variable input are added to a fixed set of factors of production, the additional outputs decrease and a point is eventually reached after which the total output stops increasing, and may even decrease. Almost anyone who has used commercial fertilizer knows how easy it is to use too much and burn the plants.

That this principle accurately describes what happens as inputs of fertilizer are varied in growing Aroostook potatoes, is evident in Chart 23, which presents the results of varying the fertilizer inputs on the experimental plots at Aroostook Farm over the period 1927–1940. The rainfall and temperature are, of course, the average for this period. The fertilizer was 4–8–7 or 5–8–7, and the rotation was potatoes, oats, and clover in all these trials. Note how rapidly the total returns increase at the start. This was because these plots were conditioned for these experiments for five years by growing potatoes upon them without

[5] A 5–8–12 fertilizer formula means that 5 pounds in each 100 of the fertilizer consists of nitrogen, that 8 pounds in each 100 consists of phosphoric acid, and that 12 pounds in each 100 consists of potassium. The rest of the 100 pounds consists of other elements used in the various chemical compounds along with the fertilizer elements, and a considerable amount of inert material that serves as a diluting agent.

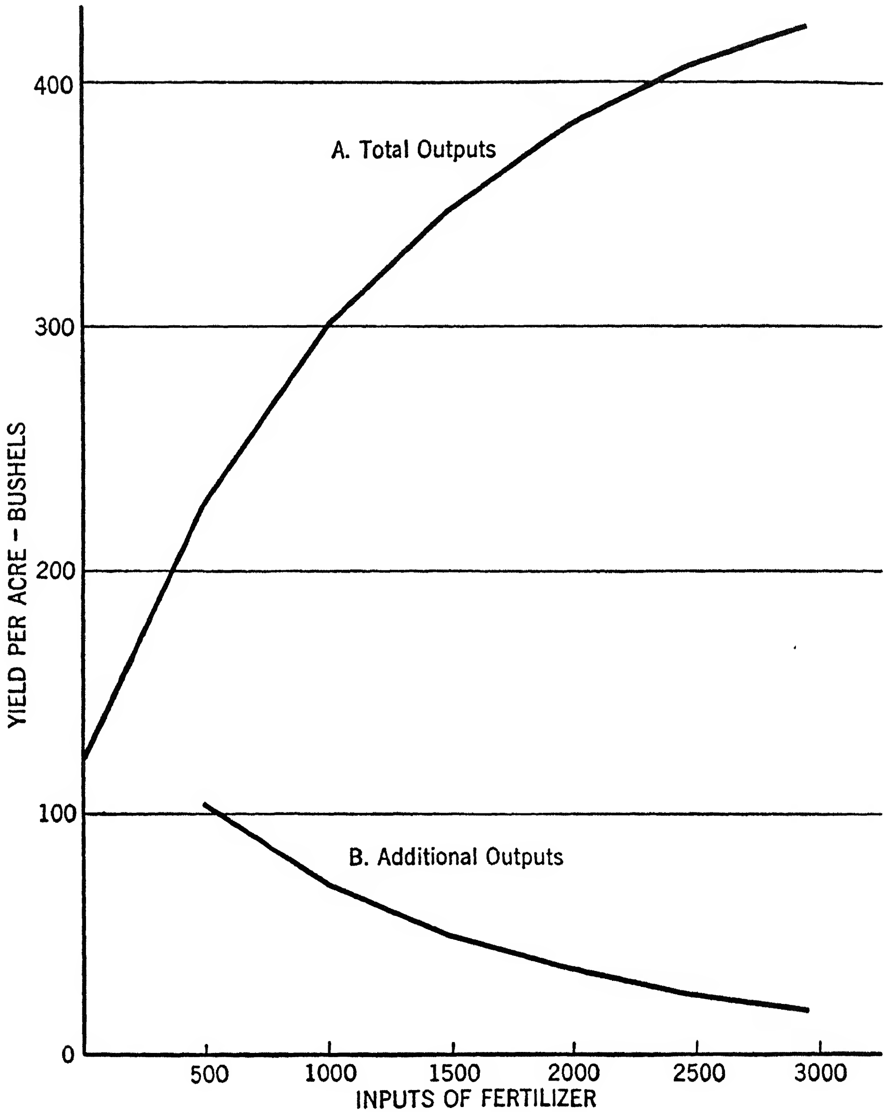

CHART 23. Total and additional outputs of potatoes on Aroostook Farm as inputs of fertilizer are increased from 500 to 3,000 pounds per acre, 1927–1941. Formula, 4–8–7; rotation — potatoes, oats, and clover.

using any fertilizer. In this condition they yielded only 123 bushels per acre with no fertilizer applied. The data for the chart are given in Table 9.[6]

[6] *Joseph A. Chucka, Arthur Hawkins, and Bailey E. Brown, *Potato Fertilizer — Rotation Studies on Aroostook Farm, 1927–1941*, Maine Bull. 414. 1943.

TABLE 9. INPUTS AND OUTPUTS OF POTATOES, 4–8–7 FERTILIZER, AROOSTOOK FARM, 1927–1941

Fertilizer inputs (lbs.)	*Output or yield per acre (bu.)*	*Additional output (bu.)*	*Percentage of last additional output*
None	123		
500	226	103	
1,000	297	71	69
1,500	346	49	69
2,000	380	34	69
2,500	404	24	70
3,000	421	17	70

These are, of course, already out-of-date, since the Aroostook potato farmers are no longer using the 4–8–7 or 5–8–7 fertilizer. If the Maine Agricultural Experiment Station were to start another set of trials using 5–8–12 fertilizer, they too probably would be out-of-date by the time ten years of results had been collected. The general slope of Curves A and B, however, is likely to be about the same regardless of the strength of the fertilizer. This is particularly true if W. J. Spillman was right in his hypothesis that additional returns decrease according to a constant ratio, as in the last column of Table 9. Each additional output in the table is the same percentage less than the preceding one. His hypothesis fits these Maine data closely.[7]

Even if these curves fit exactly the Aroostook Farm soils, it is not safe to use them without proper adaptation on other soils and types of land. One of the principal differences is that most land will not be as depleted of fertility as that used in these experiments. If 1,000 pounds of fertilizer is applied to land which has been receiving 2,000 pounds of fertilizer every third year, or two years in five, the amount which it will add to the product is likely to be somewhat less than the seventy-one bushels shown in the table. Phosphate in particular tends to be carried over in the soil from one year to another. On the other hand, the yields under actual farming conditions will be lower than on the experimental plots.

These differences may not, however, affect the *slope* of the curve — the additional outputs may be in the same ratio as on the chart. The whole level of the curve is likely to be higher or lower — more likely

[7] *Use of Exponential Yield Curves in Fertilizer Experiments,* U.S.D.A. Tech. Bull. 348, 1933. Also see W. J. Spillman and Emil Lang, *The Law of Diminishing Returns.* New York, Chicago, World Book Company, 1924.

lower — under actual farming conditions. Or it may be that because of the plant nutrients already in the soil on a farm, only the right half of the curve fits. Finally, these particular input-output data are for a particular three-year rotation, and the results may be different if some other cropping system is used.

Although these curves are not likely to fit any one farm closely, it is better to use them than no curves at all. The best procedure for any farmer is to use these curves till he can accumulate records on each of his fields that he can use in adapting the curves to fit them. Within a few years, he will be able to determine whether his level is higher or lower, and by about how much, and also which part of the curve fits his conditions. With more years of records, he can come closer and closer to the true situation.

The next step in the analysis is to determine the most profitable rate of use of fertilizer. This is very simple. All one needs to do is match the receipts from sale of the additional potatoes with the expenses connected with the additional fertilizer. The point at which to stop in applying fertilizer is at *the point where the last unit of input just pays for itself.* Table 10 presents the cost data that are involved in such a determination. It appears that at potato and fertilizer prices prevailing in the area before the war, 2,500 pounds of fertilizer paid for itself, but not 3,000 pounds. The "other" expenses are extra costs, other than picking, of harvesting and storing the additional output, including the machine-operating costs of the extra trucking and warehousing. Extra storage is needed only with the larger crops. It is assumed that the same regular labor

TABLE 10. ADDITIONAL INPUTS, OUTPUTS, EXPENSES, AND PROFITS PER ACRE, ON THE BASIS OF CHART 23, AND OF THE COST-RATES AND PRICES IN THE OPERATING STATEMENT

Inputs of fertilizer	*Additional outputs (bu.)*	*Additional receipts*	*Additional expenses*				*Expenses per bushel of additional output*
			FERTILIZER	LABOR PICKING	OTHER	TOTAL	
none							
500	103	$63.86	$10.00	$2.06	$1.03	$13.09	$0.13
1,000	71	44 02	10 00	1.42	.71	12.13	.17
1,500	49	30.38	10.00	.98	2.49	13.47	.27
2,000	34	21.08	10 00	.68	2.34	13.02	.38
2,500	24	14.88	10.00	.48	2.24	12.72	.53
3,000	17	10.54	10.00	.34	2.17	12.51	.74

force will handle the extra crop, since this labor force must be maintained on the farm the year round in any case.

To determine precisely the amount of fertilizer which it pays to use, one ordinarily needs a chart like Chart 24. The middle curve on this chart presents the results obtained in the last column of Table 10. At the prices and cost-rates used in this table, it would have paid to use

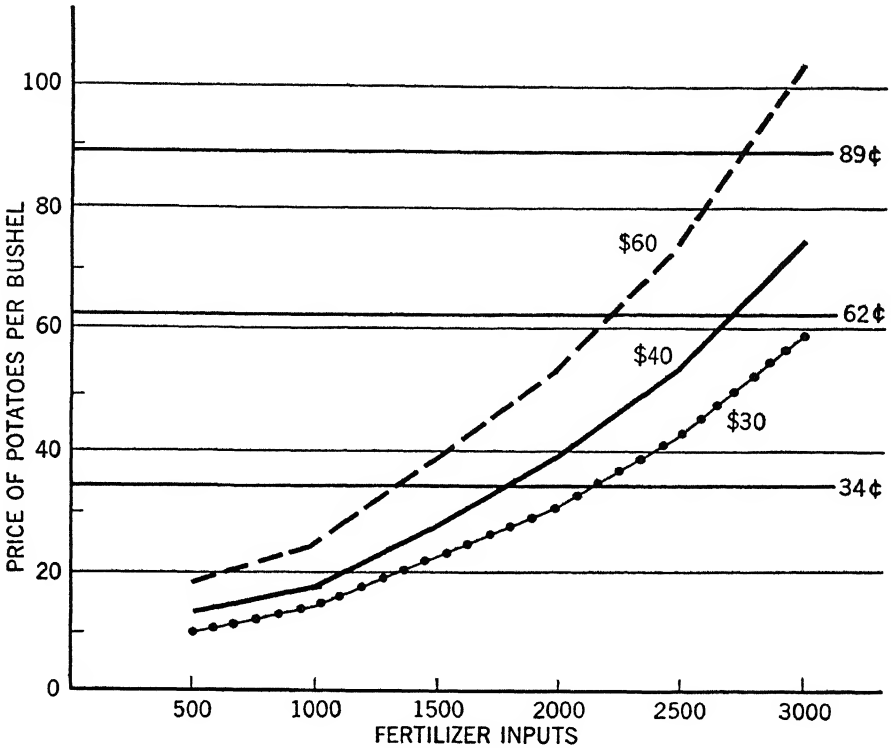

CHART 24. Costs of additional outputs of potatoes at three different prices of fertilizer, matched against three levels of potato prices.

about 2,700 pounds of fertilizer. At the low 1937 price of 34 cents, and the same cost-rates, 1,775 pounds would have paid best. With potatoes at 89 cents, more than 3,000 pounds would have paid for itself.

Now suppose that the price of fertilizer is $60 a ton rather than $40. The point of most profitable use of fertilizer would be as indicated in the upper line of the chart, around 2,200 pounds with potatoes at 62 cents, and 2,750 pounds with potatoes at 89 cents. With fertilizer at $30 a ton, however, it would pay the grower to use 3,000 pounds of fertilizer with potatoes at 62 cents.

To the extent that weather and yield fluctuations accounted for the difference between 34 cents and 89 cents in these two years, the grower could have done nothing about it in planning his use of fertilizer. It would have been better for him to count on the average price of 62 cents and use 2,700 pounds of fertilizer than to guess on the weather. If, however, the price promises to be low because of a general business depression, he can make an adjustment for this, and should by all means do so. There is no object in his putting additional fertilizer into a crop when he is not going to get his money back.

Again it must be stressed that these results are based upon a three-year cropping system consisting of potatoes, oats, and clover. They would be different under other cropping systems. Furthermore, they are based upon the soil and other conditions at Aroostook Farm. The individual farmer will need his own data before he can be sure about his conclusions.[8]

Chart 25 shows how the weather may affect the results. The upper curve represents three years of high rainfall on the Aroostook plots, and the lower curve, three years of low rainfall. With application of 1,500 pounds of fertilizer, the high rainfall produced 89 more bushels per acre than the low rainfall; with application of 3,000 pounds, it produced 136 more bushels. The land is unable to utilize large amounts of fertilizer effectively if the plants do not have enough moisture to assimilate it. It was pointed out earlier that the Aroostook area seldom experiences a real drouth. The average rainfall during July and August in the three years of "heavy" rainfall was 7.8 inches as compared with 5.1 inches in the years of "light" rainfall. In some other potato-growing areas, late summer drouths are a more serious hazard. In Michigan and Wisconsin, for example, not only is the rainfall less dependable, but the soils contain more sand and have less water-holding capacity. In fertilizer trials conducted in Michigan in 1931–1937, only from 600 to 800 pounds of fertilizer were applied, and the increase in yield obtained was from 36 to 69 bushels per acre.

The problem of rate of application of fertilizer can also be broken down to advantage into the three major components of artificial fertilizers, nitrogen, phosphate, and potash. In the Maine trials, four formulas were used which were identical for phosphoric acid and potash, but had a range of 0, 2, 4, and 6 per cent of nitrogen; similarly four which varied only the phosphoric acid, and five which varied only the potash.

[8] Constructing tables and charts like Table 10 and Chart 24, and revising them yearly as needed, is a proper function of an agricultural extension service; also furnishing guidance as to how to adapt them to individual farms.

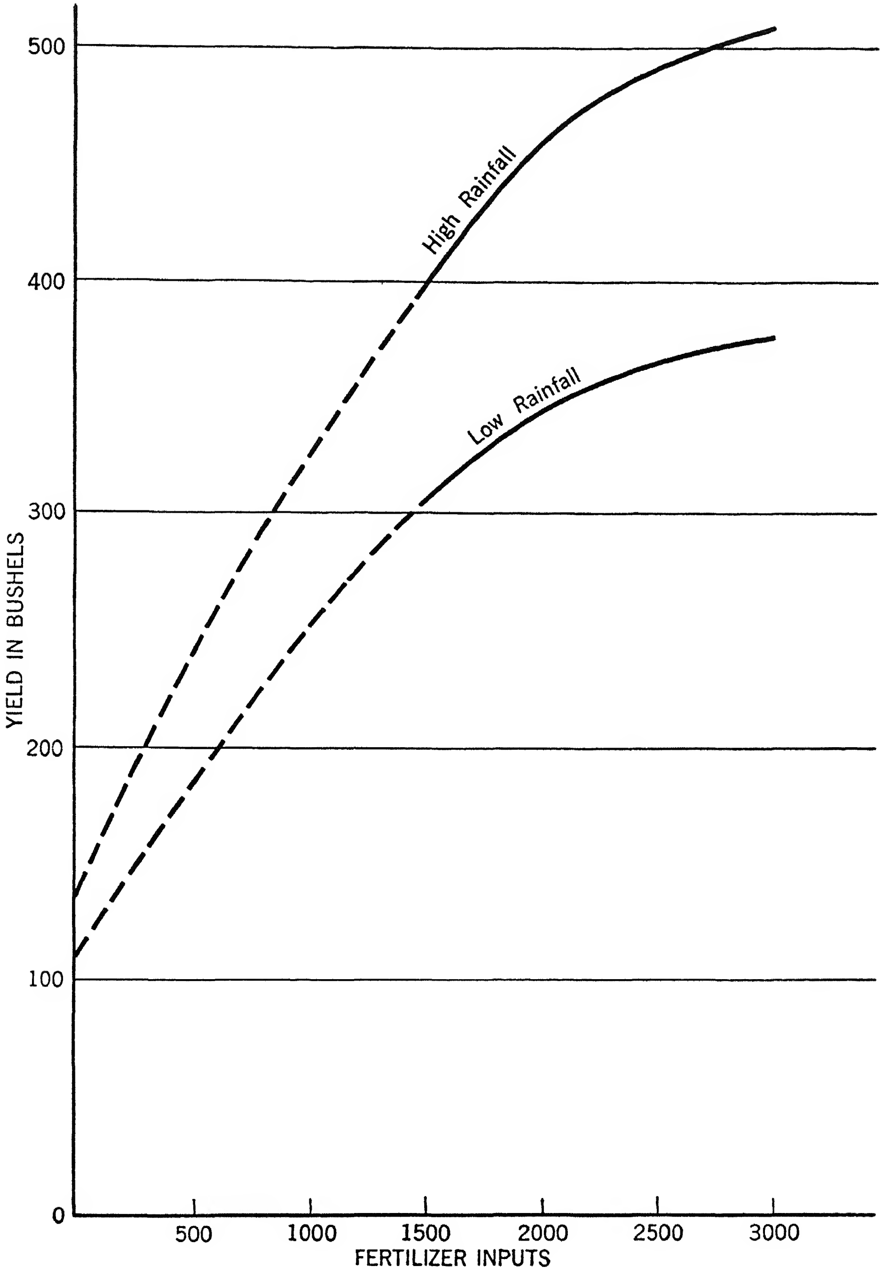

CHART 25. Total outputs of potatoes in three years of high rainfall and three years of low rainfall.

The results are shown in the three curves in Chart 26. Most of the effect of nitrogen was obtained with only 2 per cent of nitrogen in the formula; with phosphoric acid, all the increase was obtained with the addition of 2 per cent; and with potash, the yields were still increasing with the addition of 14 per cent. The price of fertilizer varies with the proportions of these three elements. A 4–8–14 formula cost $34 per ton in 1940, compared with $32 for a 4–8–7 formula. The balancing of additional costs and outputs, therefore, really needs to be somewhat in terms of particular formulas. Because of the extra freight on the inert material in the low-test fertilizers, those used in the area in 1940 cost 11 per cent more per unit of nitrogen, phosphoric acid, and potash than the high-strength fertilizers used.

Quality of the crop also has to be considered. In the Maine experiments, the percentages of tubers grading U.S. No. 1 averaged over the twelve years as follows:

no fertilizer	58 per cent
1,500 pounds	90 per cent
2,000 pounds	91 per cent
2,500 pounds	92 per cent
3,000 pounds	93 per cent

Thus, within the ordinary range of fertilizer use, 1,500–3,000 pounds, the increase in percentage grading U.S. No. 1 was very small, but below 1,500 pounds, an increasing fraction of the crop would be sold as No. 2's, or as culls to starch factories. If the quality were to be improved notably by use of fertilizer, the price line in Chart 23 would rise toward the right instead of being level. Quality would thus be an additional factor causing more fertilizer to be used. It would be a more important factor at a high level than at a low level of price.

The amount of fertilizer to use is also influenced by the residual effects of the fertilizer applied to potatoes on the oat and clover crops following. Table 11 presents these effects as nearly as they can be approximated from the reports of the fertilizer trials on Aroostook Farm. With 2,500 pounds of fertilizer used, the yield of oats was 11 bushels larger than with 1,500 pounds of fertilizer, and the yield of clover 430 pounds larger. At 50 cents a bushel for the oats, and $12 a ton for the clover, these increases would add $8.08 to the income per acre. Another 500 pounds of fertilizer would add only $2.56 to the income. One therefore needs to combine the effects on the oats and clover with those on potatoes. Some account, however, must be taken of the additional expenses and labor connected with the higher outputs of these crops.

The simplest procedure for including all these effects is to set up

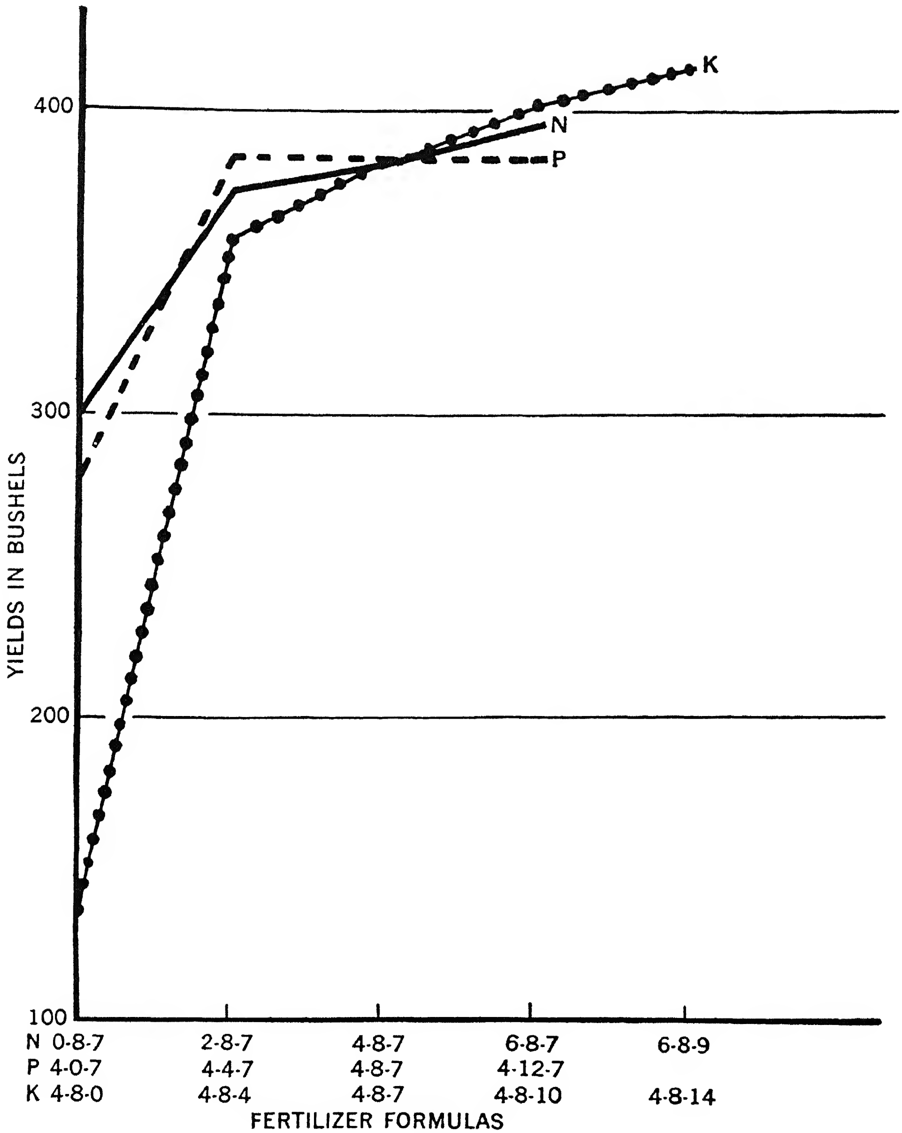

CHART 26. Total outputs of potatoes varying only the nitrogen in the fertilizer, varying only the phosphate, and varying only the potash.

alternative budgets for the different fertilizer inputs, the same as for cropping systems, in which the additional receipts from all the crops are included in the receipts column, and the additional expenses of all the crops in the opposite column. Such budgets really need to be computed only for the inputs of fertilizer which are near the critical point.

This would mean, in the problem being considered, budgets for amounts of fertilizer between 2,500 and 3,000 pounds with prices such as prevailed in 1935–1939.

TABLE 11. RESIDUAL EFFECTS ON YIELDS OF OATS AND CLOVER OF VARYING INPUTS OF 4–8–7 FERTILIZER APPLIED TO POTATOES IN A POTATO, OATS, AND CLOVER ROTATION, AROOSTOOK FARM, 1931–1941[a]

Fertilizer used	*Average acre yield*	
	OATS (*bu.*)	CLOVER (*lbs.*)
none	34	1,660
1,500	43	2,490
2,000	50	2,560
2,500	54	2,820
3,000	56	3,080

[a] Adapted from Tables 23 and 28, Maine Bulletin 414.

OTHER RATE-OF-APPLICATION PROBLEMS Other problems in rate-of-application that are important on potato farms are the amount of seed to use, the number of sprayings or dustings, and the number of cultivations. Space will allow only brief discussion of these here, but similar problems will arise with other systems of farming. They all involve an input-output relationship with decreasing additional returns in the same way as does the use of fertilizer. The common practice in Aroostook County is to use around 20 bushels of potato seed, but the range is from 16 to 30 bushels. In general, more seed is used with heavier applications of fertilizer. In the Midwest, where very little fertilizer is used, from 8 to 12 bushels of seed are used. More seed has also come to be used as methods of disease control have been improved.

In 1940, Aroostook County potatoes were sprayed or dusted six times, at an acre cost of 61 cents for materials for each spraying, and $1.17 for materials for each dusting. Calcium arsenate, to kill the "potato bugs," was combined with the Bordeaux in the first one or two applications. The labor per acre for spraying was 0.9 hours; for dusting, 0.4. The horse-labor hours were twice the man-labor hours. Two thirds of the spraying and dusting was still being done with horses in 1940. The equipment costs for spraying were estimated at 70 cents an acre in 1940, for dusting, 40 cents per acre. Much of this latter cost was overhead and would be the same whether the number of sprayings was three or eight.

The problem, however, is more than simply the frequency of sprayings. It may take the form of how early to begin spraying, and whether or not to put on another late spray. Other decisions are whether to spray or to dust, and what size of equipment to use. Eight- and ten-row power sprayers are now used on some of the larger farms. To answer the first of these questions, it is not enough to have data on the relation of number of sprayings to yields; the yields must be related to particular early or late sprayings. The season makes an important difference in the results. Apparently four sprayings in 1941 were as effective in Aroostook County as six in 1940. To answer the second, one needs data on the material and equipment costs and the amount of labor involved. Whether or not labor is a determining factor in deciding on a late spray may depend in large part upon the other demands for the use of labor on the farm at the time. If there is no other work to do that is very important at the time when another spraying is being considered late in the season, an increase in yield that pays for little more than the cost of the materials may be warranted. Only by setting up the data that bear on questions of this kind in the form of balancing of additional expenditures against additional receipts, can one judge the economic advantage of a particular spraying alternative on any farm.

The problem of number of cultivations of the crop fits into the same description as the intensity of the spraying, timing being important as well as frequency. The recent practice in the Aroostook area is four cultivations and four hillings with horses, or three with tractors. The major other questions involved are whether to use tractor or horse labor in these operations, and the size of the equipment to use with the tractor.

The major decision of horse versus tractor power is reserved for analysis in later chapters. It involves several factors which we are not yet in a position to discuss.

In fitting the land, the seedbed is likely to be more thoroughly prepared on farms with an abundance of tractor power than when the plowing and harrowing has to be done with horses. With the tractor, one can also work more of the soil when it is in just the right condition after a rain.

OTHER PRODUCTION PRACTICES Space can be taken only to mention a list of other managerial decisions which must be made on a specialized potato farm in Aroostook County. One of these is whether or not to use high-strength fertilizer. The conclusion of those conducting the Maine experiments is that as good yields are obtained generally with high-test as with ordinary strength fertilizers once the farmer learns a

few things about using them, and the cost per unit of plant nutrients is less. The source of fertilizer may also affect the results. In general under Maine conditions, mineral fertilizers are as satisfactory as organic fertilizers. This, however, is not true in other important potato-producing regions. Method of application of fertilizer also offers choices. Delaying the application of nitrogen has produced a somewhat higher yield in years of abundant rainfall and lower yields in relatively dry years.

The treatment of seed to prevent the transmission of scab and black scurf to the new crop is standard recommended practice, but less than half the growers think it worth while. At prices prevailing in 1930, corrosive sublimate cost 65 cents an acre and required 2.3 hours of labor. This labor is needed at a time of the year when extra labor is ordinarily hired for cutting of the seed. Other materials may be used instead at a cost of 76 cents per acre and requiring only half as much labor. Data are not available as to the effect on yields.

About two thirds of the area is now planted with certified seed, and part of the remainder with selected seed. Treating the seed will not prevent the transmission of black leg and some other diseases. The extra cost of certified seed in 1940 was 30 cents per bushel; but in 1941, it was only 8 cents. The data as to the effect of using certified seed on yields are not precise, but the yields run considerably higher in the areas using much certified seed than in those using only a little. Some growers purchase all certified seed every year; some, every second year. Also some buy certified seed for a seed plot and follow the methods of the certified seed growers. This means that they cut their tubers in quarters, inspect their fields periodically, and remove all four plants from any tuber if one of the four shows evidence of disease in its manner of growth — an operation called "roguing." This involves two or three hours of extra labor per acre. The seed stock must be handled separately and stored separately.

As to varieties, 44 per cent of the table-stock potatoes in the Presque Isle region in 1940 were Green Mountain, 18 per cent were Katahdin, 18 per cent were Irish Cobbler, and 16 per cent were Chippewa. But more Katahdins than Green Mountains are grown in the southern part of the area. The yields of these varieties are almost the same in most years. The Irish Cobbler matures earlier. If a fraction of the crop can be harvested in advance of the regular crop, this provides a little better distribution of the labor load. Market outlets, however, are very important and an early Maine crop runs into strong competition with more southern areas which at the same time are closer to the large metropolitan centers of the East.

OTHER MANAGEMENT PROBLEMS Space will be taken only to list the remaining management problems of this two-man Aroostook County farm. They involve such decisions as:

1. Types and sizes of tractors, diggers, sprayers, and other equipment, and whether to discard old but still useful equipment for newer and better equipment.
2. Whether to hire year-round labor or labor for the season; how to keep the labor force employed during the winter; the quality of labor to employ.
3. How much extra expense to incur in avoiding bruising of the potatoes in digging, picking, and handling in storage.
4. How to market: through what agency, in what containers, how far to haul, or when to sell.
5. How much money and when to borrow for various purposes, such as to expand operations, to buy new equipment, to build or enlarge a potato house, or to hold potatoes for a better price.

POTATO GROWING IN OTHER AREAS

A few comments will be helpful at this point concerning potato growing in other parts of this country. The growing of early potatoes in the South and in California fits in with truck growing and will be noted in that connection. The growing of late or main-crop potatoes is not usually as highly specialized as in Aroostook County. In Wisconsin, Michigan, and Minnesota, much of it is combined with dairy farming. In parts of Michigan, it may also be combined with dry beans and fruit. Potatoes tend to compete more or less with sugar beets in Idaho and other Western irrigated areas, as they do to some extent in the Red River Valley of Minnesota and the Dakotas and Michigan. The rotation systems in the Midwest include small grain and red clover commonly; in the irrigated areas, more often alfalfa and dry beans, sugar beets and dry peas. In the Northeast outside of Aroostook County, potatoes are commonly combined with dairying or with truck or canning crops. This is true even on the potato-growing farms of central Maine and northern New Hampshire. Only in New Jersey, on Long Island, and in an occasional county elsewhere, does one commonly find large acreages of potatoes per farm as in Aroostook County. The acreage per farm in the potato counties of Michigan before the war centered around 10; of Wisconsin, 6 or 8 acres; of the Red River Valley, 10 to 20; of Idaho, 10 or 15 acres. The chapters on diversified farming will consider the problem of combining potatoes with other crops and with livestock.

For none of the other areas are very useful experimental results available on fertilizer application. A North Carolina bulletin comes nearest to this. It presents the results of using 1,500, 2,000, and 2,500 pounds of fertilizer in three different compositions. A Connecticut report presents data like that of Chart 25 for potatoes grown continuously and in sequence with clover and timothy. A North Dakota bulletin reports the results of using 100 to 200 pounds of fertilizer per acre. A Michigan bulletin presents statistics on yields per acre for farms grouped according to "low, medium, and high" applications of the fertilizer, the average being 310 pounds per acre on table-stock potatoes, and 480 on certified seed potatoes.[9] Unfortunately, very few fertilizer experiments are set up in such a way as to furnish data that can be used in constructing curves of total and additional returns. The conductors of these experiments say to themselves, for example, that the actual production takes place somewhere between 1,500 and 3,000 pounds per acre and there is no use bothering with inputs smaller than 1,500 pounds. Often they include only two rates of application. To construct an input-output curve, one ought to know the location of at least five points.

FURTHER READING

* Harry E. Knowlton, Robert B. Elwood, and Eugene G. McKibben, *Changes in Technology and Labor Requirements in Crop Production, Potatoes*, Works Progress Administration National Research Project, Philadelphia, Pennsylvania, 1938.
* Maine bulletins by Schrumpf, *op. cit.*, especially 378 and 424.
* P M. Lombard, *Potato Production in the Northeastern and North Central States*, U.S.D.A. Farmers' Bull. 1958, 1944.

EXERCISES

1. Determine the acreages in each crop on the two-man farm described in this chapter, for Systems D, E, F, and the possible variations of these suggested early in the chapter. What level of yields would you expect with each?
2. Determine the most economical rate of use of fertilizer of the same formula as reported in Charts 22 and 23, with: (a) potatoes at 50 cents a bushel and fertilizer at $50 per ton; (b) potatoes at 25 cents a bushel and fertilizer at $60 per ton.

[9] C. B. Williams, H. B. Mann, and J. J. Skinner, *Results of Five Years' Fertilizer Experiments with Irish Potatoes in Eastern North Carolina*, North Carolina Bull. 283, 1933.
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E. J. Iddings, *Growing the Idaho Potato*, Idaho Bull., 141, 1942.
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CHAPTER VIII

The Management of One-Crop Farms — Continued

THIS CHAPTER RESUMES THE ANALYSIS OF THE MANAGEMENT PROBLEMS of one-crop farming, choosing three other instances of it, flue-cured tobacco in North Carolina, cotton in Texas, and wheat in Oregon, Washington, to exemplify the principles relating to cropping systems-rate of use of fertilizer and other inputs, and several other principles introduced here for the first time.

A. *FLUE-CURED TOBACCO FARMING IN CASWELL COUNTY, NORTH CAROLINA*

Caswell County is in the heart of the old bright-leaf or flue-cured specialized tobacco-farming area of Virginia and North Carolina. This area includes a block of counties on either side of the interstate boundary stretching halfway across these states. The 1929 type-of-farming survey classified 88 per cent of the farms in Caswell County as crop-specialty. The rest were mainly self-sufficing and part-time farms. Only six farms were called cotton farms. Crop-specialty in this section means tobacco. Yadkin County, over on the western edge of this tobacco section, crowding a little into the mountains, had three times as many general farms as Caswell County, and four times as many self-sufficing farms, but still 72 per cent of its farms were tobacco farms.

The 26,000 tobacco farms in Caswell County had average receipts of \$930 from the sale of products, of which only \$27 was from livestock products and \$9 from livestock. The living obtained by the families from their farms was valued at \$250. The average equipment of these farms consisted of buildings worth \$810 and implements valued at \$123. They averaged 1.5 mules, 0.9 cows or heifers, 0.4 calves, and 1.2 sows or pigs. The average farm had 78 acres and was worth \$2,030. By 1940, the value of this farm had declined 8 per cent, but the value of implements had increased slightly because a few farms had bought tractors,

and the value of livestock a little because a few farms had begun to produce milk for sale.

These farms are therefore much smaller than the Aroostook County farms measured in value of product and income. The typical family farm in Caswell County, however, provides about as much employment for the family as does a family farm in Aroostook County hiring no extra labor except for picking potatoes and possibly cutting seed.

These tobacco farms are much more numerous than the potato farms in the Aroostook area. They are spread over a large section of both Virginia and North Carolina. Then another large group, in southeastern Georgia, combines tobacco, cotton and sometimes peanuts to make two or three cash crops. The incomes of these, however, are no larger than those of the one-crop tobacco farms.

FARM ORGANIZATION

	Acres		*Number*
Tobacco	5.0	Mules	3
Corn	15.0	Cows (milk)	2
Rye — double-cropped	(6.0)	Heifers	1
Meadow hay	1.0	Hogs	2
Lespedeza hay	10.5	Hens	30
Sweet potatoes	0.5		
Idle cropland	25.0		
Open pasture	1.0	*Equipment valued at* $180, *buildings at* $980, *farm at* $2,600	
Woods	23.0		
Farmstead	4.0		
Total	85.0		

OPERATING STATEMENT

Receipts		$1,029	
Inventory change			
Depreciation	− $ 59		
Feed and supplies	+ 25		
Total		− 34	
Expenses			
Labor	35		
Crops — seed, feed, fertilizer, tobacco cloth, etc.	137		
Livestock	40		
Other	120		
Total		332	
Net Business Gain			$663

Preceding are the organization and operating statements for an actual tobacco farm in Caswell County. This farm was visited by farm management specialists in 1940 with a view to determining ways of reorganizing it that would increase its income. The only cash receipts other than those from tobacco were $38, $26, and $15 from the sale of sweet potatoes, chickens, and eggs. Yet this farm used the whole labor of the family and, in addition, hired 200 hours of labor at harvest time. The primary objective of this farm is to produce "hands" of high-quality tobacco carefully graded and ready for market. A secondary objective is to produce corn, meat, milk, eggs, and garden products for the consumption of the family.

The five acres of tobacco on this farm yielded 950 pounds per acre, which at 20 cents per pound, the average price received in 1935–1939, brought a cash income of $950. The 300 bushels of corn obtained from fifteen acres were all used by the livestock and by the family. The lespedeza and other hay was used by the livestock. The milk was used by the farm family as fluid milk and butter. Two hogs were killed to provide meat for the family.

The Net Gain of this farm may have been a little abnormal: the acreage of tobacco was low because of the restrictions imposed by the Agricultural Adjustment Act, but the price was somewhat higher as a result. It may be reasonably argued that prices were unduly low in the 1935–1939 years in spite of the government controls. Not shown in the operating statement are $67 of benefit payments received as an inducement to participate in the restriction program.

CROPPING SYSTEM One notices immediately the large acreage of idle cropland in this farm. This looks like a wasteful use of land resources and requires an explanation. The quality of bright-leaf tobacco is lowered when legumes are used in the rotation. The nitrogen they deposit in the soil makes the leaves dark green and coarse. But still the crop needs some organic matter in the soil. Under the prevailing practice, this is obtained by allowing the land to grow up to weeds. The 25 acres of idle land and the 5 acres in tobacco can therefore be considered as in one rotation, one sixth of this land being planted to tobacco each year. The rest of the cropland is in another rotation consisting of corn and lespedeza hay, with some rye fitted in over the winter on 6 acres, partly as a cover crop and partly to provide some green feed before being plowed under in the spring.

This rotation for tobacco has serious disadvantages. During the first two years, the weed cover is light and the land is subject to severe erosion.

As a result, the land gradually runs down from loss of fertility and from erosion. Here we find a typical example of one-crop farming on the same land persisted in from generation to generation until the land no longer returns enough to warrant its use. Equally serious, while this land is idle, it is yielding no income. What is needed is a nonlegume rotation that will keep all of the land in some crop use. The agronomists working upon this propose to follow the tobacco with a crop of winter oats in which redtop is seeded the following spring, the oats to be harvested for grain. The land will thus yield an income each year. The redtop will keep the land covered over the winter, and when plowed under in the spring will add some humus to the soil without adding legume nitrogen. The oats will be sown in the fall after the tobacco is harvested, and harvested after the spring tobacco planting.

The farm management specialists chose to follow this proposed rotation in reorganizing the cropping program for the Caswell County farm. They put 10 acres of the best tobacco land in the farm into a two-year oats–redtop–tobacco rotation. The remaining 20 acres in the present tobacco rotation, plus 10 other acres of cropland, they put into a three-year rotation of corn, wheat, and lespedeza hay. Two of the fields in this rotation, being long and sloping, were to be strip-cropped. Another 10 acres of cropland, more sloping than the rest and somewhat eroded, was to be added to the pasture after receiving treatment to build up its carrying capacity. The remaining 13 acres are so steep and severely eroded that the best use which could be devised was to put them into the perennial hay crop sericea, which has been introduced widely in the South to fit exactly these conditions.

These proposed adjustments in the cropping system could be made very easily. Some initial expenses would be involved in improving the 10 acres of pasture land, and also in preparing the land and seeding the 13 acres of sericea. These intial expenses would be offset by sales of wheat, and in most years of small amounts of hay and oats, and by savings in feed bills, as a result of the growing of 5 acres of oats and 10 acres of wheat and the sericea hay. The proposed revision would give the family more cash income even in the first year if the family was prepared to undertake the necessary work of rehabilitating the land, but the gain would be small. The important gains would come only after a few years when the yields of tobacco and corn improved, and the improved pasture and hay-land management began to provide more forage.

To realize fully on this type of revision in the cropping system, however, would presently call for adding to the livestock on the farm, and

accompanying this, still more diversification in the cropping system. This farm would then become in effect a *diversified crop-and-livestock farm*, which we are not yet prepared to discuss.[1]

The alternative that would add most to the income of this farm in the near future would be to put 15 acres of it in the proposed two-year oats–redtop–tobacco rotation. The family would need no additional help for this except at the peak harvesting period when extra help is hired anyway. The extra labor and fertilizer costs together would amount to $90, and feed sales would be reduced $25. Two additional acres of tobacco at $190 per acre would add $380 to the gross income and $265 to the net income. This increase would more than compensate the family for the increase of hours which they would spend on fitting the land and on planting and caring for the crop.

This, then, seems like the obvious reorganization for this farm. It would be *if only this farm were to make this shift*. If a majority of the flue-cured tobacco growers were to increase their acreage a half, the price would fall sharply, and the result might be that the growers had less income than before. This aspect of the subject will be discussed in Chapter XX.

INPUT-OUTPUT RELATIONSHIPS The problem of the rate of use of the input factors will be illustrated in the case of this Caswell County farm only by the use of fertilizers. The experimental data on the use of fertilizer on flue-cured tobacco in this area are inadequate. The curves in Chart 27 should therefore be taken merely as illustrative. They show the yields of tobacco in pounds, and the value of the crop in dollars, from the use of four different amounts of 3–10–6 fertilizer on some Cecil sandy loam soils in this general area, and of five amounts on some Appling sandy loams in this area. It is necessary to express the results in value terms as well as in pounds because the proportion of the crop which falls into different price classes varied with the amount of fertilizer used. For example, with 1,400 pounds of fertilizer, the poundage of the best grade of "leaf" increased from 250 to 310 while the poundage of "lugs," or bottom leaves, and of "tips" remained about the same. The Appling soils gave the larger response. This may be because the Cecil soils already had about all of the plant nutrients which this type of tobacco can use to advantage. The curve of the Cecil soils looks much like that for the Appling soils from 1,200 to 1,800 pounds. In general, the Cecil soils have a tighter subsoil than the Appling, and hence probably lose less of their nutrients from leaching. They do not, however, appear to be able to

[1] See Chapter XVIII.

convert fertilizer into high yields of tobacco — they seem to have a limited *capacity* to use fertilizers.

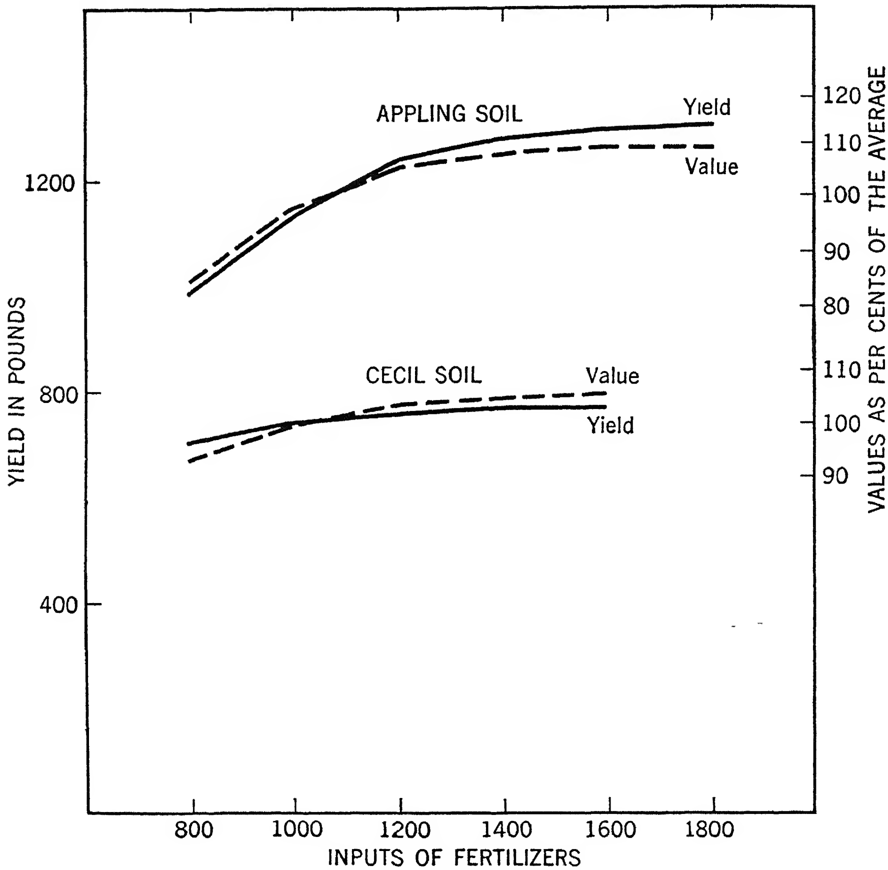

CHART 27. Total outputs of flue-cured tobacco accompanying varying inputs of 3–10–6 fertilizer, on Appling and Cecil sandy loams in North Carolina. (These curves are idealized somewhat from the results of trials conducted by the North Carolina Experiment Station.)

Chart 28 shows the additional outputs, expressed in value units, accompanying the additional inputs. Table 12 presents the data for the Appling soils used in this chart and the additional incomes and the additional expenses. The higher yields entail practically no additional expense except the fertilizer. The last column in the table reduces the additional costs to a pound basis. The 1,600 pounds of fertilizer applied paid for itself, but not the next 200 pounds. A similar analysis for the Cecil soils shows that at 1,400 pounds of fertilizer per acre, the last

additional pound of tobacco produced per acre cost 20 cents and sold for slightly under 19 cents. Something less than 1,400 pounds of fertilizer therefore represented the most profitable application on the Cecil soils. A chart like Chart 29 shows exactly where the cost lines and price lines meet on these two soils at the cost-rates and prices prevailing in 1935–1939. The reader can draw in any other price lines he wishes — for example, the 45-cent price that prevailed during the war. He can also try out the effect of paying Aroostook County prices for fertilizer.

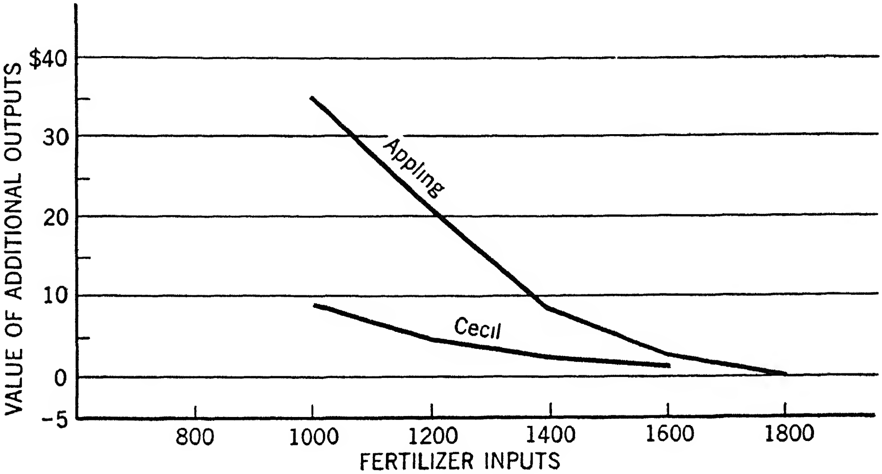

CHART 28. Values of additional outputs of flue-cured tobacco accompanying increasing inputs of fertilizer, on Appling and Cecil soils in North Carolina, 1935–1939.

TABLE 12. ADDITIONAL INPUTS, OUTPUTS, EXPENSES, AND PROFITS PER ACRE, FLUE-CURED TOBACCO ON APPLING SOILS, ON THE BASIS OF CHART 28, AND THE PRICES AND COST-RATES IN THE OPERATING STATEMENT

Inputs of fertilizer	*Additional expense*	*Additional output*	*Price per pound (cents)*	*Value of additional output*	*Expense per pound of additional output (cents)*
1,000	$2.00	150	23.0	$34.50	.013
1,200	2.00	100	22.9	22.90	.02
1,400	2.00	40	22.8	9.10	.05
1,600	2.00	16	22.7	3.60	.125
1,800	2.00	5	22.6	1.10	.40

THE UTILIZATION OF LABOR The labor force on this farm consists of the farmer himself, a son of above school age, and other family labor equivalent to one additional helper when school is not in session. Chart 30 shows the amount of labor applied by months to five acres of tobacco. The harvest-time peak load in August and September is extremely high. Field work on all other crops ceases during this period. Also for a week or so in the spring, all the other farm activities stand aside while the tobacco is being planted. The work on the other crops and on the small

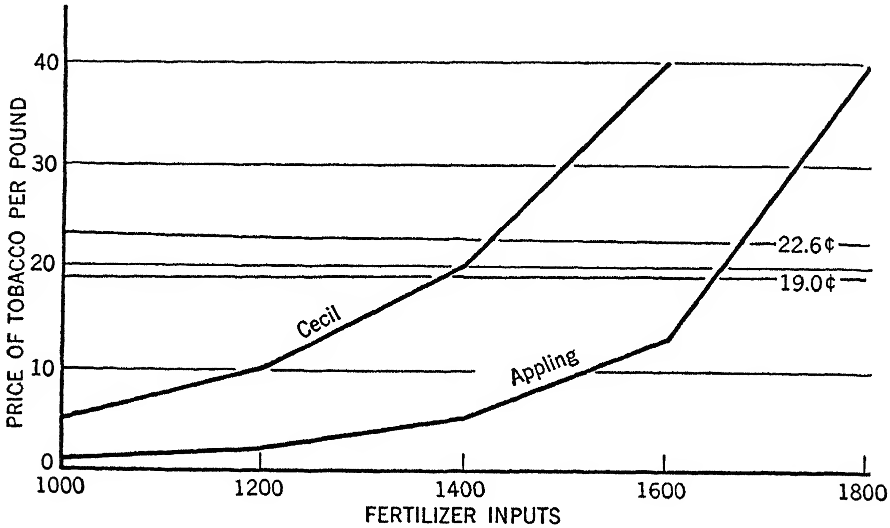

CHART 29. Prices and additional costs per pound of flue-cured tobacco accompanying additional inputs of fertilizer on Appling and Cecil soils in North Carolina, 1935–1939.

amount of livestock is fitted around the production schedule for tobacco, and handled with no additional out-of-pocket expenditures for labor. In fact, during much of this time, the labor force is really not very well employed. However, if enough other crops were added to employ the labor force during early spring and midsummer, additional labor would need to be hired to take care of them whenever their needs conflicted with those of the tobacco crop. This is the usual situation on one-crop farms.

So far as the operations other than harvesting are concerned, there need be scarcely any limit to the intensity of the care given them. With nothing else important for the family to do during June and July, an additional cultivation or hoeing that will improve the crop to only a very slight extent may be warranted. The harvest period presents a

very different situation. If the final product is to be high in quality and obtain a good market price, the harvest must be timed exactly right. No risk can be taken of letting the tobacco remain on the stalk too long and deteriorate in quality. Most tobacco growers employ all the labor they need at harvest time.

A mule and one field hand are able to take excellent care of some two or three acres of tobacco after it is planted. The mules and labor required to take care of five acres of tobacco will also be able to plow

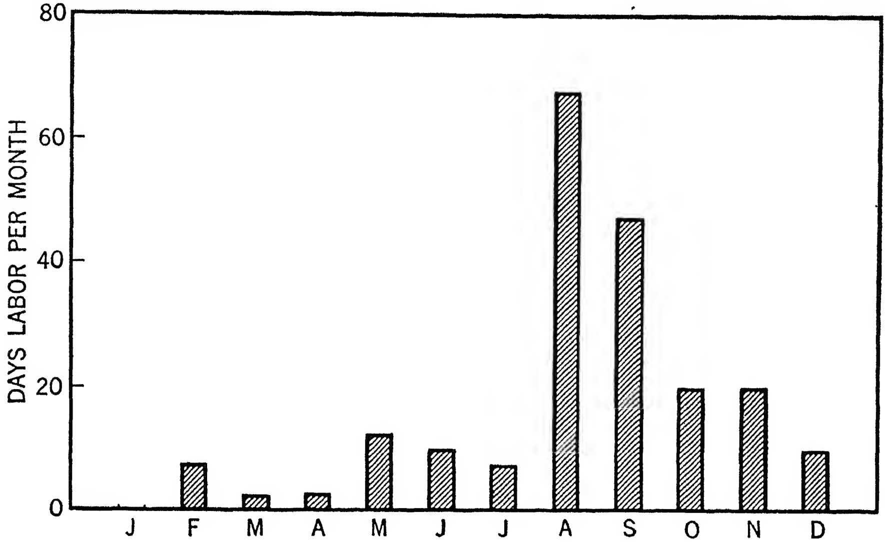

CHART 30. Labor applied by months to five acres of flue-cured tobacco in the old tobacco belt of North Carolina and Virginia.

and prepare the seedbed for that acreage in the spring, and grow enough corn and hay for feed for the mules and the few cows and pigs kept on these farms. The ordinary family farm, therefore, has no need of tractors or other power equipment. Only if tobacco growing is combined with other farming to make a diversified farm business does a tractor have any place in the organization.

B. *COTTON FARMING IN THE BLACK PRAIRIE OF TEXAS*

Cotton farming will be discussed in several other chapters of this book, in combinations with tobacco, with peanuts, and with wheat in Chapter X, with livestock in Chapter XIII, and finally in a special chapter in PART FIVE. All that is undertaken here is to describe a type

of one-crop cotton farming practiced in the Black Prairie of Texas,[2] and outline briefly its management problems.

The Black Prairie of Texas is a tract of 11,000,000 acres of land which nature so abundantly endowed that although it has been devoted mainly to one crop, cotton, except for some diversification beginning in the 1930's, it is still yielding around 170 pounds of lint cotton per acre in an average year. Before A A A crop control, the tract grew a third of the cotton crop of Texas. Chart 31 shows the boundaries of this tract as they were drawn in the 1929 type-of-farming survey, and the adjoining type-of-farming areas. It is an area clearly marked off by natural factors. Most of its soil is of one type, Houston Black Clay, and the rest is mostly Houston Clay. These soils, like those of the Black Belt of Alabama and Mississippi, are highly calcareous. The black surface layers and clay subsoils overlay beds of marl and chalk. The native vegetation was mostly tall bunch grass, but these soils have never developed a true prairie-soil profile, and are therefore classed as Rendzina. The topography, however, is of very gently undulating prairie type. The Grand Prairie area to the west is more rolling and its soils are thinner, overlying limestone. The soils to the east, except for an adjacent long narrow strip of stiff hard-to-work Wilson soils, are light, and low in natural fertility. The rainfall averages around 35 inches, of which a fourth falls in April and May, and a half less in cotton-picking time, August and September.

How remarkably uniform the land in this area is may be judged from the fact that in 1929 all but 18 per cent of the land was in crops, and 61 per cent of the cropland was in cotton. A little more small grain is grown in the northern than in the southern part of the area. The use of land in farms in 1929 and 1939 in three of the counties shown in Chart 31 is shown in Table 13. Only two of these counties are all typical Black Prairie. Bell County reaches into the Grand Prairie area. The percentage of the land in cotton was reduced about a half by the A A A program in all three counties between 1930 and 1940. Some of the cotton land went into corn; a little into oats, except in Bell County; a little into sorghums; and a very little into "other crops" (hay and wheat). The major portion of it went into plowable pasture and "other cropland," which consisted of idle or crop-failure land. Some of this latter was winter oats that did not come through the winter and spring of 1938–1939.

Fully as striking as the shift away from cotton was the increase in the average size of farms in these counties in this decade, from 87 to 140 acres

[2] C. A. Bonnen of the Texas Agricultural Experiment Station, and Ronald W. Jones of the Division of Farm Management and Costs of the Bureau of Agricultural Economics, supplied much of the information for this section.

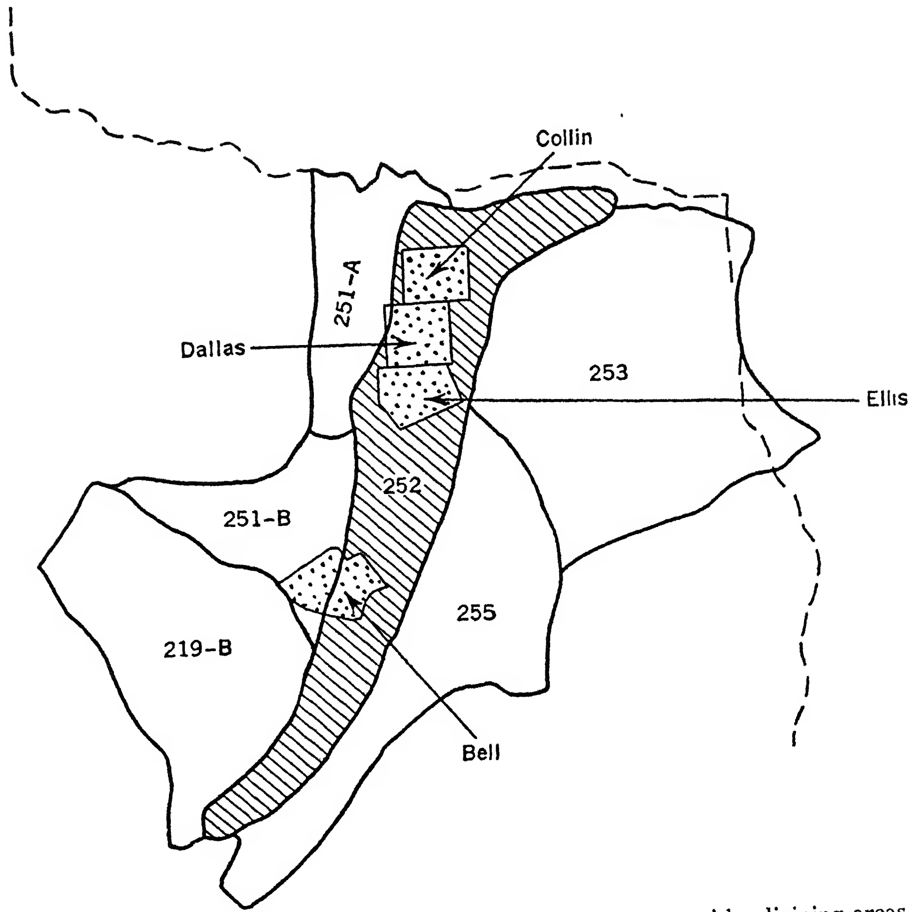

CHART 31. The Black Prairie type-of-farming area of Texas, with adjoining areas, showing the location of Collin, Ellis, Dallas, and Bell Counties

252 Black Prairie
253 Piney Woods — cotton, some truck and fruit
255 Postoak Strip — cotton, self-sufficient, general
251 Grand Prairie — cotton, general farming, some cash grain
219B Edwards Plateau — range livestock

in Ellis County, 113 to 152 in Bell County, and 83 to 107 in Collin County. This came about mainly through the absorption of cropper farms into owner farms and the combination of tenant farms. Only in this way could a family get enough cotton to employ them as fully as before. In 1940, only 60 per cent of the farms in these three counties were rented, compared with 72 per cent in 1930. The number of croppers in Texas declined from 105,000 to a third of this number between 1930 and 1940.

TABLE 13. PERCENTAGE OF FARM LAND IN DIFFERENT USES IN THREE BLACK PRAIRIE, TEXAS, COUNTIES IN 1929 AND 1939

		Cotton	*Corn*	*Oats*	*Sorghums*	*Other crops*	*Other cropland*	*Plowable pasture*	*Other*
Ellis	1930	61.4	9.6	4.9	2.2	2.0	4.4	3.0	12.3
	1940	30.4	14.5	7.2	4.3	3.8	15.3	10.1	14.5
Bell	1930	37.3	10.9	5.9	2.5	1.2	3.4	1.5	37.2
	1940	17.6	14.8	4.8	4.7	2.1	6.7	7.2	42.1
Collin	1930	43.5	15.4	6.2	.8	9.8	5.1	5.8	13.4
	1940	24.2	18.7	5.9	1.1	10.6	12.5	10.9	16.2

A SMALL FAMILY FARM The most common sizes of farms in the Black Prairie in 1940 were around 60 to 80 acres, but Ellis County has about as many around 40 acres as around 80 acres. The cropping is about the same for all sizes. A 60-acre nonmechanized owner farm is chosen to represent this area. The prices and yields used are the 1935–1939 averages.

The gross receipts of this farm were therefore 80 per cent from cotton. This probably is somewhat below the average, since only part of the farms in the Black Prairie have sows and sell pigs. The same farm in 1929 would have had thirty-five acres of cotton, less corn and pasture and less livestock. It received an A A A payment of $135, not given in the operating statement, for shifting part of its acreage from cotton and for related practices.

CROPPING SYSTEM Clearly the major management problem on such a farm is its cropping system. The specialization in cotton on such farms, combined with similar specialization on the cotton farms of other parts of the South, has helped to depress the price of cotton to unprofitable levels. A United States cotton crop 20 per cent above normal in the 1920's sold for $170,000,000 less than one equally below normal.[3] When exports were sharply reduced in the 1930's, the large crops caused immense carry-overs to accumulate.[4]

Equally important is the effect on the land of having two thirds of the cropland in this area in a cultivated crop or idle each year. Although the cotton fields have gentle inclines, erosion has been severe, and the topsoil has been carried away much faster than it has been formed. Of a group of 190 farms in the center of the Black Prairie surveyed in 1933,

[3] John D. Black, *Agricultural Reform in the United States*, Chapter 4.
[4] See Chapter XX.

FARM ORGANIZATION, 1941

	Acres		Number
Cotton	19	Mules	3
Corn	13	Milk cows	2
Oats	2	Other cattle	3
Sorghums	4	Sows	1
Hay	3	Hens	60
Other cropland [a]	4		
Meadow pasture	4		
Other plowable pasture	7		
Other land	4		
Total	60		

[a] Mostly idle or crop failure

Inventory

Land	$2,200	Livestock	$430
Buildings	950	Feed and supplies	180
Machinery	270	*Total*	$4,030

OPERATING STATEMENT, 1940–1941

Receipts		
Cotton — 3,290 lbs. at 16.4¢	$540.	
Cottonseed — 4,300 lbs. at 2.5¢	110	
Butterfat — 160 lbs. at 32¢	51	
Calves — 2	21	
Hogs — feeder pigs, 985 lbs. at 7.1¢	70	
Chickens — 130 lbs. at 14¢	18	
Eggs — 350 doz. at 20¢	70	
Total		$880
Inventory change		
Depreciation — buildings	− 22	
— machinery	− 47	
— workstock	− 23	
Total		− 92
Expenses		
Feed	$62	
Crop expenses — ginning, threshing, seed	49	
Machine operation — fuel and repairs, including share of farm auto	48	
Taxes	34	
Miscellaneous	25	
Total		218
Net Business Gain		$570

a fourth had lost 75 per cent or more of their topsoil, and three fourths of them more than a fourth of their topsoil. Experimental plots at the Temple Station in this area, on land with a $3\frac{1}{2}$ per cent slope, lost 89 tons of topsoil per acre in the five years 1932–1936 when the cotton was planted up and down the grade.[5] Also as the soils deteriorate from erosion, the root rot to which cotton and other plants are subject on these heavy soils becomes much worse. In bad years, a half of the plants in some of the fields may be affected with root rot before picking time. Winter cover crops, to protect the bare and mostly unfrozen land between cotton crops, are not feasible because of root rot, and winter oats are subject to rust. The rust-resistant varieties introduced have not proved to be resistant after a few years. Insofar as the area had a cropping system before the A A A came upon the scene, it consisted of cotton and corn following each other irregularly, but three times as much land was in cotton as in corn. The remaining acreage was in some forage crop like redtop cane. The principal effect of crop control was to increase the corn acreage to almost equal that of cotton.

The average yield of cotton from 1930 to 1943 was 170 pounds lint; of corn, 18 bushels; of winter oats, 25 bushels. If all these crops were sold at prevailing prices in the area in 1941, the cotton crop (including cottonseed) would bring $31 per acre; the corn, $12; and the oats, $11. Converted into pork, this corn would sell for $15 per acre. The corn and oats converted into dairy rations would sell for around $14.

As long as this land will keep on yielding cotton at present rates, the budgeting of alternatives on these farms at the usual sets of relative prices is, therefore, likely to show reduced farm family incomes as land is shifted from cotton to corn, oats, sorghums, and pasture. For example, substituting corn for half the cotton on the farm described, and feeding the corn to hogs, would reduce the net cash income of the farm by $140, assuming no increase in A A A payments. Substituting winter oats for half the cotton and feeding the oats to dairy cows would reduce the net cash income by nearly $200. The upper limit on profitable cotton acreage, with no A A A payments on cotton, seems to be reached when the farm no longer produces enough feed for its mules, one or two cows, and a few pigs and chickens to provide food for the farm family. These conclusions would be modified somewhat if new types of disease-resistant winter oats yielding 40 to 50 bushels per acre, that are now being bred, were to survive in this area, or if hybrid corns could be developed that are better adapted to Southern summer weather.

[5] "Soils and Men," *Yearbook of Agriculture*, U.S.D.A., Washington, D. C., 1938.

EROSION CONTROL The effects of the continuous row-cropping on the land may be offset in large measure by erosion control. The plots at the Temple Station mentioned above lost only one sixteenth as much topsoil when strip-cropped on the contour with a rotation of redtop cane, Sudan grass, oats, and vetch that kept one third of each field out of cotton. Simply planting of cotton on the contour reduced the topsoil loss considerably.[6] In dry years, conservation of rainfall as well as topsoil is also important in the area. Cotton yields on Houston Black Clay soils in the droughty year, 1936, were 88 pounds higher, and corn yields four bushels higher, on terraced than on unterraced fields. Over a three-year period, the cotton yields were 23 per cent higher, and the corn yields 14 per cent higher.

QUALITY FACTORS The surplus of cotton during the war years, and to a less extent before the war, consisted of the lower grades of cotton. The basic quality factors are spinnability and the tensile strength of the yarn made from the cotton fibers, and staple length is taken as the principal indicator of this. That it is only a rough indicator has been recognized for some time, but no method of including other factors in the commercial grading has been developed. Tests conducted by the United States Department of Agriculture in cooperation with the Texas Agricultural Experiment Station show, however, that variety is the most important single factor in yarn strength. Yarns from the Acala and Deltapine varieties had tensile strengths a fifth to a fourth higher than those from the Qualla, Mebane, and Hi-Bred varieties. Difference in staple length only partly accounts for these differences in tensile strength. The first two varieties usually have staple lengths of $1\frac{1}{32}$ inches or longer, and the last three, of around $\frac{29}{32}$ of an inch. Area and weather affect quality, but apparently all varieties about alike. The yields per acre are as high for the Acala and Deltapine varieties as for the others.

Hence, if cotton could be paid for by variety as well as grade, the farms specializing in the better varieties would receive premium prices over and above the usual grade differences at no increase in costs. To obtain these benefits in full, however, the producers would mostly need to organize into one-variety communities, and market-pricing practices would need to be revised. Without these changes, the growers producing Acala and Deltapine cotton would receive only the usual premium for $1\frac{1}{32}$ staple over $\frac{29}{32}$ staple, which in 1935–1939 was about a half-cent per pound.

[6] *Soils and Men*, pp. 634–8. Texas soil scientists doubt if the saving was a half.

MECHANIZATION Discussion of the mechanization of cotton production is mostly reserved for Chapter XXXVII. The small family farm here used as an example has little inducement to mechanize even with the changes brought by the war. Even if this farm had 120 acres in place of 60, its hired labor bill in 1939 would have been only around $200. However, if wartime levels of farm wages in this area — more than three times the prewar levels — continue long after the war, and competition for markets lowers cotton prices, pressure to save labor will become strong even on 120-acre farms.[7] More important, the enlargement of farms that occurred between 1930 and 1940 will be strongly augmented. The average labor input of an acre of cotton in the Black Prairie before the war was 50 hours, of which half was preharvest. Consider in contrast the situation in the High Plains and Rolling Prairie areas of western Texas, where the rainfall is only 20 to 25 inches, the cotton plants are smaller and less chopping is needed. In the High Plains area, the labor input is only 20 hours per acre, of which 6 hours is preharvest. The parallel figures for the Rolling Prairie acre are 25 and 9 hours. Using two-row tractors, a family in western Texas can take care of a large acreage until harvest, and hand-snapping in place of picking the cotton reduces the harvest labor a third. With modern methods of stripping the cotton now being introduced, two men do the work of twelve. Two-row tractor equipment came into use on some of the larger Black Prairie farms during the war. Mechanical pickers, however, may prove to be better adapted to the Black Prairie than the strippers.

Of course, if wages decline sharply in the South, mechanization will be slowed down, but it is not likely to be stopped. According to the 1945 census, the number of tractors doubled in Texas between 1940 and 1945. The increase was greater in the Black Prairie than elsewhere in Texas. The biggest demand has been for two-row tractors. This suggests further enlargement of farms. The control of weeds by flaming was used to a very limited extent in this area in 1946.

C. *WHEAT FARMING IN THE PACIFIC NORTHWEST*

The types of one-crop farming we have thus far considered all represent intensive cultivation, and two of them small-scale operation. Let us now turn to an example of extensive and relatively large-scale operation — wheat farming in central Washington and Oregon. The farms in this section produce wheat for sale and characteristically grow no

[7] Piece rates for cotton picking were 70 cents per 100 pounds of seed cotton in 1939. They had risen to $2.60 by 1943.

grow wheat on the same land two or three years in succession, other crops or livestock are likely to be included and the farming is no longer highly specialized. The territory in Washington and Oregon which specializes this highly in wheat is shown in Chart 32. Adjoining it in the east, and reaching over into Idaho, are two areas, the larger commonly referred to as the Palouse area, which have a little more rainfall and now combine field peas, sweet clover, and an increasing amount of livestock with wheat growing.

The type of farm organization on the specialized wheat farms may be judged by the 1930 census data for "cash-grain" farms in a group of four counties in the center of this area — Gilliam and Sherman Counties in Oregon, and Adams and Lincoln Counties in Washington. From 70 to 85 per cent of the farms in these four counties are cash-grain farms, which averaged by counties from 980 to 1710 acres per farm in 1929, with from 35 to 42 per cent of their acreages in harvested cropland. These farms were then being operated much more with horses than with tractors. They averaged from 13 to 17 horses per farm, from 2 to 3 milk cows per farm, and from 6 to 14 head of other cattle. About 90 per cent of the gross values of product, ranging from $5,100 to $7,400 per farm, were obtained from sales of cash grain. The machinery equipment of these farms even at this time was valued at from $2,400 to $4,300. The farms ranged in value by counties from $30,400 to $45,000.

The United States has much specialized wheat growing outside of these areas in Washington and Oregon. One-crop wheat areas are scattered over the vast intermountain region, and some parts of the northern and southern Great Plains fit this description. On the Great Plains, however, more cattle are often combined with wheat growing. Outside the United States are large areas in Canada, Australia, Argentina, and Russia which have essentially the same climatic conditions as those in the Washington-Oregon area. In fact, the areas which can grow wheat but no other crop are so extensive, in comparison with the world's need for wheat, that a large part of the world's wheat is now grown on such lands. These areas, with their modern mechanized methods, produce wheat so abundantly and so cheaply that the growers even in these areas themselves have suffered from low prices much of the time since 1930. Also as a result, very little land in the United States which can grow other crops as well as wheat is now planted to wheat. Some European countries, however, are keeping such land in wheat by imposing exorbitant tariff duties, amounting before the war in some cases to more than a dollar per bushel.

The major management problems of these wheat farms relate to

rainfall — not only the scarcity of it, but its irregularity. William Cavert has compiled historical series of wheat yields on several farms in North Dakota. One series with an average yield of 11.4 bushels since 1893 includes fourteen years when the yield was 7 bushels or less. Another with an average of 17.6 bushels since 1904 includes nine years when the yield was less than 10 bushels. Another running back to 1920 only includes six years of complete crop failure, although the average is 13.6 bushels.[8]

Moreover, there seems to be a tendency for several above-average years to follow each other and also several below-average years. One hardly cares to speak of regular cycles, but, nevertheless, wet and dry years do not occur in a purely random fashion. In Montana, each year from 1906 to 1916 inclusive had above-average precipitation; from 1928 to 1939 inclusive, below-average precipitation, except for three years that were only slightly above average. In one of the North Dakota series, the ten-year average yield in the 1920's was over 18 bushels; in the 1930's, just over 4 bushels; and the 1940–1944 years averaged 23 bushels. This tendency for wet and dry years to occur in rather long sequence is more apparent in the northern third of the Great Plains and mountain region than in the lower third.[9]

Under these circumstances, the first requirement of good management is conservation of such moisture as does fall. A wheat crop of 12 bushels per acre involves the growing of around 1,100 pounds of dry matter, including straw and roots. Allowing 600 pounds of water per pound of dry matter, a 12-bushel yield of wheat requires only a little over three inches of water. The rest of the moisture that falls is carried off in the torrents following severe local thunderstorms, or is evaporated from the surface in the next few days following such a storm, or is later drawn to the surface by capillary action or lost through transpiration from the leaves of weeds and grasses. Relatively little of the water reaches the deeper underground levels; the forces drawing it to the surface are stronger than those drawing it downward. The wheat grower's task is to help the wheat plants save enough of the water to mature a crop. By good tillage, he can increase the infiltration of such rain as does fall, and by keeping the weeds down, prevent the transpiration of moisture through their leaves. By good fallow farming methods, he can save some of the water from one season for the growing of the crop in the next.

Closely related to conservation of water are control of erosion and

[8] *Long Term Wheat Yields on Each of Six North Dakota Farms*, Circular 45–5, Research Division, Farm Credit Administration of St. Paul, 1945.

[9] See Chapter XXXVI

control of weeds. In spite of the low rainfall, water erosion may be serious on sloping fields because of the heavy downpour in thunderstorms. Wind erosion is nearly always serious. These are regions of great wind movement. Under the fallow system practiced, the land does not have a growing crop upon it from August of one year until April of the second following year, a period of twenty months. The stubble protects the land considerably during the first winter, but after that, under the conventional methods of fallowing, the land is entirely bare for a year and the surface soil is finely pulverized. Only a little wind under these circumstances causes the soil to blow around and to pile up along with the tumbleweeds in the fence rows. In recent years, however, the rod-weeder and the duckfoot cultivator have come into use. These destroy the weeds, but leave the surface crust nearly undisturbed. Still more recently, a system of "trashy fallow" has been developed. This leaves the stubble and the straw from the combining on the top of the ground instead of completely turned under. Other methods now used are cultivating at right angles to the prevailing wind, with ridging up of the soil, and cropping and fallowing in alternating strips at right angles to the wind. These methods not only prevent wind erosion but reduce very greatly the runoff, so that ten inches of rainfall will much more nearly grow a crop of wheat than under the old methods.

Weed control is a serious problem in any one-crop system of farming with close-grown crops. If no native weed gradually encroaches on the cultivated crop, some foreign one whose growth habits closely resemble those of the crop, like wild oats in the spring-wheat region, becomes rampant. Twenty-five years ago, before cultivated crops were interspersed with spring wheat in the Red River Valley of North Dakota and Minnesota, in some years as much as 20 per cent of the weight of the wheat delivered at the local elevators consisted of wild oats and other weed seeds. The weed problem, however, is not as difficult with fallow farming as it is with continuous cropping. The fallowing destroys the perennial weeds and sprouts as well as the annuals.

A TYPICAL FARM A typical farm in this area includes about as much additional-rented as owned land. The landlord receives one third of the wheat crop as rent and nothing for the use of the range and waste land. To simplify the explanation, the farm presented here is fully owned. The prices and yields used are the averages for the years 1935–1939.

Not included in the $4,035 of net profit are $1,540 of A A A payments received in the average 1935–1939 year.

FARM ORGANIZATION, 1939

	Acres		Number
Wheat	750	Horses	6
Fallow	750	Beef cattle (all ages)	30
Range and waste	700	Dairy cows (all ages)	4
	2,200	Brood sows	2
		Chickens	100

Equipment: A 60-h.p. Diesel tractor, an 18-foot combine, three 4-bottom gang plows, ten 8-foot sections of spike-tooth harrows, five 8-foot sections of spring-tooth harrows, four 12-foot rotary rod-weeders, and five 10-foot grain drills.

Inventory

Land	$39,500	Machinery	$6,000
Buildings	5,500	Livestock	2,500
Total		$53,500	

OPERATING STATEMENT, 1938–1939

Receipts		
Wheat sold,[a] 9,000 bu. at $1.00	$9,000	
Livestock — 10 head of cattle, 6 hogs, a few chickens and some butterfat	980	
Total receipts		$9,980
Inventory changes		
Depreciation	− 1,200	
Livestock	− 200	
Total inventory changes		− 1,400
Expenses		
Hired labor — 10 months at $68 a month	680	
Contract labor	250	
Feed	225	
Fuel and oil	830	
Sacks and twine	220	
Repairs and servicing	610	
Taxes	930	
Miscellaneous	800	
Total expenses		4,545
Net Business Gain		$4,035

[a] Not including 750 bushels used for seed, 300 bushels of cracked and low-grade wheat used as feed, and 80 acres of wheat cut for hay or pastured (around the edges of the fields, or poor patches).

If half of this farm had been rented, the landlord would have received 1,675 bushels of the wheat, but he would have paid $380 of the taxes. The operator would then have had a net profit of $2,740 plus $1,300 of the A A A payments.

THE CROPPING SYSTEM The major decision in any specialized wheat area is what system of fallow to employ. It has been pointed out that the borderline between the two-year crop-and-fallow system and continuous cropping is highly uncertain and that there are many twilight zones where the choice is very close. Some wheat growers also follow the system of one year of fallow and two or three years of wheat. In order to decide on this major issue, the wheat grower needs data on the wheat yields obtained in his area, adapted so far as possible to his particular farm, under continuous cropping, under the alternate crop-and-fallow system, and under the three- and four-year sequences with one year of fallow. Moreover, he needs these data for long periods, twenty years or more, unless he is going to figure out some way of anticipating stretches of dry and wet years.

Very few data of this sort are available. A general rule has sometimes been laid down that the alternate crop-fallow system should be used when yields under this system do not exceed sixteen bushels per acre. Experiments in Utah, Kansas, and elsewhere have shown that below this limit the total weight of wheat over a series of years is as large with the alternate crop-fallow system as with continuous cropping. On the plots at Garden City, Kansas, for example, the yields were ten bushels per acre with the two-year system and five bushels with continuous cropping. Since the costs are lower for the fallow year than for the crop year, the net income is greater with the two-year system.

In much of the northern Great Plains area, crops two years out of three seem to yield the most wheat, at least in the sequences of years with above-average precipitation. The farmers, therefore, tend to drift toward the three-year system or toward continuous cropping in periods of above-normal rainfall; and in the other direction in the dry sequences, but usually with something of a lag.

This raises the question as to the possibilities of shifting from one cropping system to another according to the rainfall. One good guide for such shifting is available — the moisture content of the soil at planting time. This determines the germination of the seed and the early growth of the plant. It is possible to forecast wheat yields with considerable certainty merely on the basis of the moisture content of the soil at seeding time. Only in an occasional year does enough rain fall during

a growing season to grow a crop after it is planted. But what can the dry-land farmer shift to if his soil moisture is too low? Nothing except grain sorghum in most areas. About all that the farmer risks is the seed and gasoline necessary for the planting, since most other costs are incurred anyway. Under these circumstances, most of them gamble on making a wheat crop even though they commonly lose. They could, however, when the moisture is low, fallow rather than plant part of their land, and save up moisture and plant nutrients for a better crop the next year, and shift more of their land to fallow the year after if the rainfall still continued low; and do the reverse of this if the moisture is high. It may also be possible to develop a better understanding of rainfall sequences and a better system of reporting and analyzing rainfall.

Then there is always the possibility of shifting from wheat to cattle, or part way in that direction. No doubt the prevailing judgment is sound that much land converted from range to cropland in 1915 to 1931 should have been left in range. If an area is subject to sequences of eight or ten years when only one wheat crop in two or three will pay to harvest, it is doubtful whether it should grow wheat at any time. Families that settle on such land in the wet sequences will not save enough in the good years to support them over the poor years. If they combine wheat growing with cattle raising on relatively large acreages, they can withstand the dry periods better. This combination is prevalent in areas with considerable rough land, and will be discussed further in Chapter XIV.

EQUIPMENT Once the cropping system has been established, the next major management problem of importance on these farms is the choice of type and size of equipment. The three most important and most expensive machines on a specialized wheat farm are the tractor, the combine, and the truck. Tractors range from small wheeled machines with ten horsepower on the drawbar, costing $1,000 when new, to large track-laying Diesel tractors with fifty or more horsepower on the drawbar, costing $4,000 or more. For the same horsepower, the track-laying types are the more expensive, but where the land is steep, they are more satisfactory. The Diesel tractors cost more than the gasoline tractors, but burn a cheaper fuel. If the different sizes of tractors are each used at around their optimum capacity, the investment in tractor power per crop acre has proved to be about the same regardless of size. However, the larger tractors are less likely to be used at their capacity. Combines are less costly than tractors, but still represent a heavy invest-

ment, and are used for only a short period each year. At least a small truck is needed to haul fuel for the tractor, seed into the field, grain to market, and to transport the farmer to and from the fields. If the operator hauls all his grain to market, he needs a larger and more expensive truck. Much of the grain, however, is hauled by custom truckers.

The farm described above is equipped with a Diesel tractor. To use such a tractor efficiently, at least 1,500 acres in wheat and fallow are needed, and a total investment in machinery, at 1939 prices, of $6,000 or more. To equip even a 640-acre farm growing 300 acres of wheat annually with a gasoline wheeled tractor of 30 horsepower, a combine to match it, and a small truck, at prices prevailing in 1939, required an investment of $3,200 with new machines. If one could assume that such machines were used until worn out, the average investment would be half this amount. Actually, obsolescence is a very large factor, and probably two thirds of the original costs will more nearly represent the average investment required. One will find on many wheat farms a large graveyard of defunct machines discarded while still useful because a greatly improved machine had been developed. With most of the farmers in the area shifting to new machines, there was little market for the old ones.

Because of the very great importance of equipment in the operation of farms such as here described, the organization of the farm frequently needs to be based in large part upon the capacity of the most important single machine or two machines. The tractor is the most important single machine, and it is necessary that its capacity and the land be fitted to each other. Also the other machines must be such that the tractor can pull satisfactorily and that will use somewhere near the full capacity of the tractor.

The choice of size of machine needs to be considered from other points of view than unit costs. The season within which an operation can be performed may be definitely limited. Perhaps the most critical operation is seeding. This must be done not only when moisture and soil conditions are satisfactory, but in time to permit adequate growth. Length of day and temperature affect the growth and yield of both winter and spring wheat. Late-sown spring wheat has much lower yields than early-sown. Grain needs to be harvested when it is ripe or it may be damaged by adverse weather or will shatter out and be lost. If the fallow is not cultivated in time, much moisture is lost through the growing weeds. Elmer Starch gives the following time limits for each job under Montana conditions: Cultivation and seeding: 15–18 days. Fallowing:

first operation, 20–25 days; second operation, 10 days; third operation, 10 days; fourth operation (if necessary) 10 days. Harvesting: 15 days. Total: 88 days. The capacity of a machine determines the time required to complete one of these operations. The capacity of the machine depends upon its rate of travel, its width, and time required for servicing and other stops. A three-plow tractor plows about an acre an hour. A six-plow tractor pulling a 36-foot drill seeds 120 acres per day. Between these two extremes is a wide range in capacities.

Given such limits as the foregoing for each operation, and data on the performance rate for each machine, the farm manager can choose the size of machine that will fit best into his situation. On most farms thus far, the problem has been more often one of enough cropland to use the available sizes of equipment economically. In the last ten years, however, smaller and more suitable types of equipment have become available.

LABOR The labor load is as highly uneven on these specialized wheat farms as on all single-crop farms, but when the alternate crop-fallow system is followed, the fallow operations provide some employment at other than planting and harvesting periods. Chart 33 shows the distribution of labor on a Montana spring-wheat farm when following this system, and also when growing wheat two years out of three, and three out of four. The more wheat, the poorer is the seasonal distribution of labor; the work load at the peak planting and harvesting seasons increases, as does also the idle time. With the proper season for these operations sharply limited, the operator has increasing difficulty in performing the necessary work. He may lengthen out the period of seeding and harvesting, but this results in lowered yields and crop losses. He may work longer hours, including night work, but there are limits to this. Only by hiring temporary labor at peak seasons can the extra load of work be handled. A more usual choice is a smaller acreage of land per farm, which offsets the gain from growing more wheat on the same land when the rainfall permits. To level out the labor load evenly over the season, an important further step needs to be taken — the cropping program needs to be diversified to include feed and forage crops as well as wheat, and livestock. (Such diversification is discussed in Chapter XIV.)

SCALE OF OPERATIONS The important farm organization problem of size of business, or scale of operations, is reserved for special consideration in a later chapter. Thus far in this and the preceding chapter, we have taken certain size units as given and considered best how to organ-

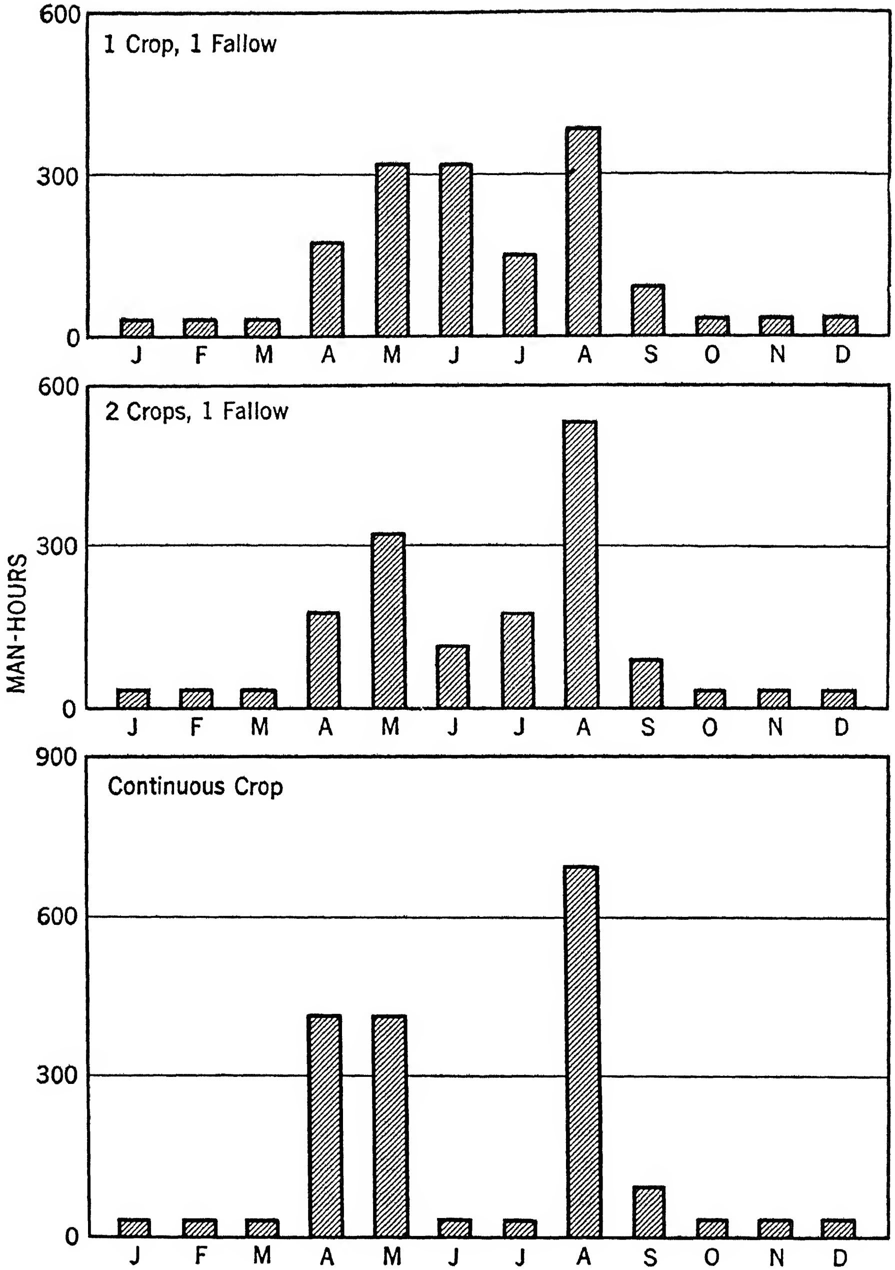

CHART 33. Seasonal distribution of labor on a Montana spring-wheat farm with 800 acres of cropland and following three systems of fallowing.

ize and manage these. All that will be done here is to call attention to one aspect of the problem of size; namely, that of the need for fitting together the size or capacity of the machines, and the capacity of the labor force, with the land area to be handled.

If the farmer has a large acreage of land, his problem becomes simply one of obtaining the number, size, and types of machines that will operate this area of land to best advantage. As suggested earlier, in many parts of the United States, including the wheat-growing areas, the problem often takes another form: namely, to obtain the area of land necessary for the best use of given size of machines. Many farmers fail to obtain the necessary land for this. This happens in part because of the way in which land has passed from public to private ownership in this country. At the time the West was being homesteaded, farming was being done with horse-drawn machinery, and the "homestead" unit of 160 acres, and later of 320 acres, was what one family could operate with the machines of that day. The moldboard plow, the binder, and the stationary thresher were the tillage and harvesting implements then in use. Later, the use of larger teams of horses and somewhat larger machines increased the acreage that one family could handle. The header was introduced as a harvesting machine during this period. Then came the tractor and the combine. These changes called for successive increases in the size of the farm, but these increases were not easily made. None of the neighbors might be willing to sell, at least at a reasonable price. A tract located at some distance might be for sale, and in this way scattered holdings often developed. With the introduction of the tractor, however, and the development of the complementary machines to be used with it, the pressure toward larger units became very strong, so that in the last two decades the family-size farms have contained larger and larger acreages.

At any given time, however, a large proportion of the farms have been too small for optimum use of equipment. Also, the additional acreage has often been rented rather than purchased. This has made for an unstable tenure, since this additional-rented land has shifted from one operator to another at frequent intervals. The process of adjusting farm acreage to farm machines of current size has not yet run its course.

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Ben H. Pubols, Alden E. Orr, and Carl P. Heisig, *Farming Systems and Practices and Their Relationship to Soil Conservation and Farm Income in the Wheat Region of Washington*, Bull. 374, 1939.

* E. A. Starch, *Farm Organization as Affected by Mechanization*, Montana Bull. 278, 1933.

* B. H. Thibodeaux, C. H. Bates, and C. A. Bonnen, *Farm Business Report, Elm Creek Watershed, Black Prairie Area, Texas, 1933*, College Station, Texas, 1937.

F. L. Underwood, *Flue-cured Tobacco Farm Management*, Virginia Bull. 64, 1939.

EXERCISES

1. Are there any strictly one-crop farms, generally comparable to those described in Chapters VII and VIII, in your home county (or in any other local area with which you are familiar)? If so, describe their organization and operation. Are they the dominant type of farm in that area? If so, why? If they are a relatively infrequent type, why do they exist?
2. Prepare an Operating Statement that fits approximately one of the typical one-crop farms in your area. Then if possible prepare a revision of this to fit a promising alternative organization.
3. If you were beginning farming, what aspects of one-crop farming would attract you to it? What aspects would appear unattractive to you?

CHAPTER IX

Specialized Livestock Farms

IN THE LAST TWO CHAPTERS, WE HAVE CONSIDERED THE MANAGEMENT problems of one-crop farms, and some of the principles of farm management involved in these. As our next step, we need to analyze in similar manner a livestock farm with only one kind of livestock. Many farms in the United States fit roughly under this description. The 604,000 farms classified as *dairy* farms in the 1930 type-of-farming analysis were receiving, on an average, two thirds of their income from dairy production, plus some additional income from the sale of cows and calves. The 165,000 poultry farms were obtaining practically all of their income from the sale of poultry and poultry products. The 71,000 farms classified as *stock-ranch* were getting, on an average, nearly four fifths of their income from sale of livestock and wool. Finally, there were 479,000 *animal-specialty* farms which also obtained more than four fifths of their income from the sale of livestock and livestock products (principally wool). Many of these, however, have more than one kind of livestock — for example, the hog and beef-cattle farms in the Corn Belt.

This is too large and varied a group of farms to take in all at one sitting. Let us first get some of the major principles clearly in mind by observing their simpler applications. Let us take first a specialized livestock farm that not only sells virtually nothing except livestock and livestock products, and *also buys all its own feed*, so that we shall be free of all the complications arising from trying to fit feed and livestock enterprises to each other. The type of farm which we have chosen for this is a "dry-lot" dairy farm such as one finds around the cities of southern California, specifically one around Los Angeles. Here is a city with more than two million people within its metropolitan area, supplied with its fresh milk daily by perhaps 1,500 commercial dairies, with 90,000 to 100,000 cows, which are situated on its outskirts and in other areas close by. Most of these herds are kept in dry lots the year round. Only here and there in the area is there a spot with a little pasturage or where a little feed can be grown. The cows are bought also, usually

just before freshening; and many are sold for butchering at the end of their first lactation period. The herds are turned over, on the average, in less than three years.

These dry-lot dairies, therefore, resemble factories more than they do farms as we usually think of them. The operator buys his raw materials, feed, and cows, hires labor, and turns out one product. Feed of any kind can ordinarily be purchased in any quantity, and the feeding program is not dependent on the farm production for feed.

Why are these "factories" located around Los Angeles? Why is the milk not produced in the San Joaquin, Yuma, or Imperial Valleys, only 250 miles or so distant, and shipped to Los Angeles? This is an interesting case in the theory of localization of production, discussed in Chapter XVI. Suffice here to say that the irrigated valleys named grow alfalfa mainly and they would need to import their grain. Most of it would come by boat to Los Angeles or San Francisco and then be reshipped to these valleys. Also the milk which is made from alfalfa hay is bulkier than the alfalfa, and would have to be hauled every day in refrigerated trucks, whereas the alfalfa is baled and can be hauled at any time. The shorter the haul for fresh milk, the better for it.

A 90-COW DRY-LOT DAIRY, LOS ANGELES AREA

The farm taken for an example has 90 cows. This is approximately the average for the commercial herds in the area.[1] This is an owner-operated farm, although half of the farms in the area are rented for cash. It has five acres of land, used for exercise yards, corrals, and the like, no horses, and a very small garden with a few fruit trees. An attempt is made to keep 75 cows in milk. For every 35 purchased each year, 30 are sold, the other 5 being death losses. Two bulls are kept, and the calves are sold within a week after birth. The investment in this enterprise is $24,800, including a sizable inventory of feed.

The $4,320 does not include the value of the family's use of the dwelling and of farm and garden products. It is compensation to the farmer and his family for their management and labor, plus return on the investment, which latter might be reckoned at 5 per cent of $24,800, or $1,240.

Alfalfa hay is the mainstay of the ration, with 415 tons of it being fed. The concentrates consisted of 36 tons each of barley, bran or millrun, and beet-pulp molasses, and 27 tons each of cottonseed meal and copra,

[1] The average for all herds in the area is somewhat lower because around a fourth of the herds are family farms with fifty cows or less. The 826 farms classified as dairy farms in this area in 1929. before Los Angeles was as large a city as now, included 275 that hired no labor.

a total of 162 tons. Also 230 tons of green feed were purchased from irrigated farms near at hand.

OPERATING STATEMENT (*at 1941 Prices*)

Receipts		
Milk — 10,000 pounds per cow, 3.9% milk, or 390 lbs. butterfat per cow; at $3.04 per cwt., or 78¢ per lb. of butterfat	$27,378	
Cull cows — 30 at $84	2,520	
Calves — 85 at $4	340	
Miscellaneous — manure, cull bulls, etc.	554	
Total receipts		$30,792
Expenses		
Feed	14,875	
Cows — 35 at $140 per head	4,900	
Bulls	54	
Labor — machine milker at $150 per mo.	1,800	
— general dairy hand at $135 per mo.	1,620	
— relief machine milker — 52 days at $5.50	286	
Hauling milk	1,037	
Interest on current loans	330	
Miscellaneous — veterinary, repairs, supplies	450	
Taxes, license, insurance	900	
Total expenses		$26,252
Inventory Changes — depreciation of buildings and equipment	— $220	
Net Business Gain		$4,320

The high production per cow is due in some measure to the culling out of a third of the cows each year before the end of their lactation period. The cows are bred early after freshening and kept in heavy milk production as much of the year as possible. This partly explains the need for severe culling.

The major production management problems of these farms are the rate of feeding, the composition of the ration, the rate of culling, the management of the labor force, the buying of replacements, and selling. These farms have a high cash-expense ratio — on the 90-cow farm, 86 cents out of each dollar received. This means high vulnerability to price changes — if feed and labor expense rise 10 per cent while milk prices remain the same, net profits are cut 40 per cent.

RATE OF FEEDING

The two feeding problems for such an enterprise are the composition of the ration and the rate of feeding. As we did with fertilizer and potatoes, we shall assume a given composition of the ration and first settle

the question as to the rate at which this should be fed. No studies comparable with those in the use of fertilizer in Maine have been made of the rate of feeding dairy cows in the Los Angeles milkshed. A vast amount of experimental feeding of dairy cows has been carried on in this country, but most of it has not been done in such a way as to produce the curves of input-output relations which are needed in determining the most profitable rate of feeding. Fortunately, however, the Department of Agriculture did carry out in 1936–1939, in collaboration with ten agricultural experiment stations, a major project of the type needed;[2] and statistical analyses of the rate of feeding and input-output relations made in the Los Angeles milkshed indicate that the results of the national study fit reasonably well after allowance is made for the special circumstances in the area.

To make our analysis fit in with these statistical results, we will use the ration then in common use in the Los Angeles milkshed. This consisted of 25 pounds of alfalfa hay, two pounds each of barley, beet-pulp molasses, and copra meal, and a pound each of bran and cottonseed meal. This is 33 pounds daily of total feed, slightly more than six tons annually. In terms of total digestible nutrients (T D N), the unit that scientists have devised to adjust for the different proportions of water and crude fiber in different feeds, this recommended daily ration represents 7,000 pounds of actual feed. It therefore averages 57 per cent T D N. The alfalfa hay runs around 52 per cent, the wheat bran around 61 per cent, the barley around 80 per cent, and the rest mostly around 75 per cent. Included in the 7,000 T D N's are 1,450 pounds of digestible crude protein. The ratio of protein to the other nutrients, the so-called *nutritive ratio*, was 1 : 3.7; that is, one pound of protein to 3.7 pounds of carbohydrates and fats combined, with the fat weighted $2\frac{1}{4}$ because a pound of fat furnishes this much more energy than a pound of carbohydrates.

MAINTENANCE PLUS PRODUCTION The major difference between the input-output relations in the feeding of animals and the growing of plants is that the bodies of the animals must be maintained while they are producing — in the same way that a tractor pulling five plows must pull itself along as well as the plows. This maintenance part of the ani-

[2] Delaware, Indiana, Maryland, Michigan, Mississippi, New Jersey, New York (Geneva), Pennsylvania, South Dakota, and Virginia. The United States Department of Agriculture's part in this project was conducted jointly by the Bureau of Agricultural Economics and the Bureau of Dairy Industry. The results were published in Technical Bulletin 815, *Input-Output Relationships in Milk Production*, May, 1942, under the authorship of Einar Jensen, John W. Klein, and Emil Rauchenstein of the Bureau of Agricultural Economics, and T. E. Woodward and Ray H. Smith of the Bureau of Dairy Industry.

mal's ration is an overhead charge which varies with the size of the animal's body. A large amount of careful research done in Europe and the United States has led to the acceptance of the following maintenance requirements for a 1,000-pound dairy cow: on a daily basis, 7.925 T D N pounds, of which 0.7 must be digestible crude protein. This is equal to 2,920 T D N pounds per year. A 1,200-pound cow will require 20 per cent more than this for maintenance.

The additional feed required per pound of 4 per cent milk produced has also been investigated very carefully. Haecker at the University of Minnesota arrived at the input figure of 0.343 T D N pounds. Savage of Cornell arrived at the figure of 0.350. Morrison, after reviewing all of this research, has expressed the results in *Feeds and Feeding* in the form of a range from 0.311 to 0.346. The middle point of this range, 0.32, will be used in the analysis following. This comes out almost exactly one pound of total digestible nutrients for three pounds of 4 per cent milk. The inputs vary with the butterfat content of the milk, from 0.27 for 3 per cent milk to 0.38 for 5 per cent milk. The crude protein requirements are also expressed as a range in the Morrison standards, the figure for 4 per cent milk being 0.060. The comparable figure for 3 per cent milk is 0.055, and for 5 per cent milk, 0.066.[3]

A few applications of these standard inputs may help us to understand them better. A 1,000-pound cow, as already explained, will need 2,920 T D N pounds to maintain her body. If she produces 7,000 pounds of milk, she will need 2,310 additional T D N pounds as her production ration. This makes a total of 5,240 T D N pounds. As we shall explain in more detail later, the cows in the Los Angeles milkshed average larger than the 1,000-pounds and produce more than 7,000 pounds of milk per cow. However, the third of the cows that are disposed of each year are not maintained during the period when they are giving no milk, nor during the period of low milk output. The ratio of maintenance ration to production ration is therefore extraordinarily low in this area.

The usual analysis of dairy cow feeding is based on the following assumptions: First, the cow produces no milk at all until she is fed in excess of her maintenance ration, beyond point M in Chart 34; and from this point onward, the milk output is in strict proportion to the production ration. Thus, if a cow is fed 2,000 pounds of T D N in excess of her maintenance ration, her milk output is twice what it would be

[3] Plants also have what amounts to maintenance and production rations. The maintenance ration is the plant food required to grow the plant and maintain it while the seed is being formed and matured. The production ration is the plant food which goes into the seed itself. With plants grown in ordinary soils, however, the two parts of the ration cannot be separated readily by experimental methods.

if she were fed 1,000 pounds in excess. The increase continues at this rate until the cow reaches the limit of her capacity to convert feed into milk, Point L in the chart. Beyond this point, a dairy cow converts whatever she eats into gain in weight. The output of milk has reached its limit at Point L. The chart is therefore divided into three parts: the weight-losing part, the milk-ration part, and the weight-gaining part.

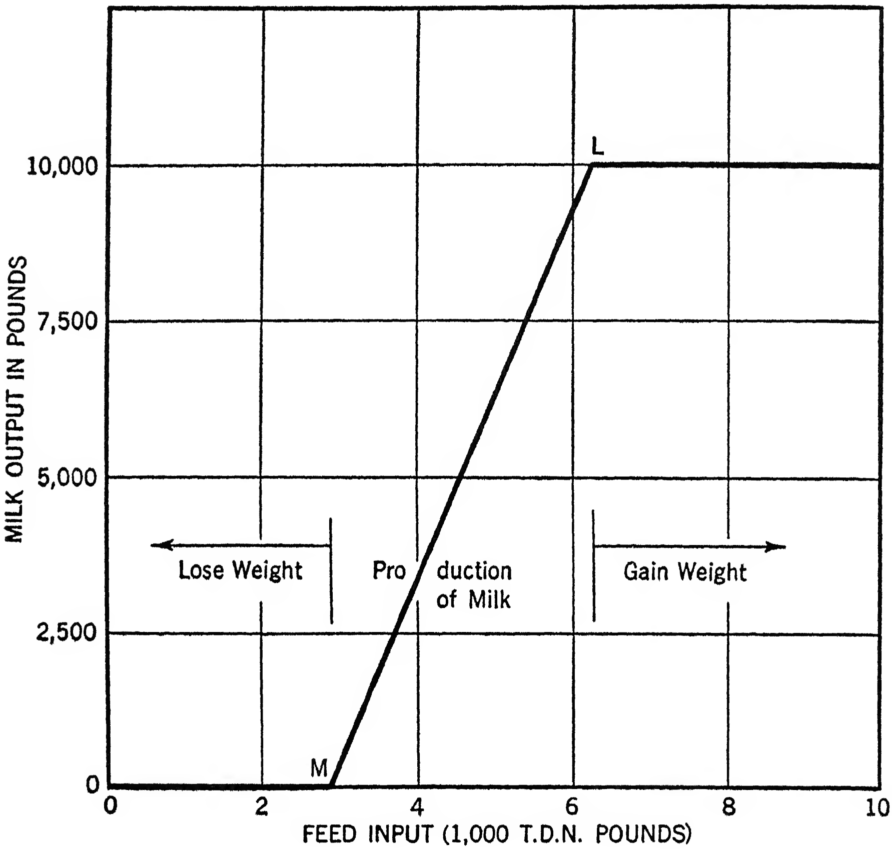

CHART 34. Relation between feed input, milk production, and weight changes, for cows in the Los Angeles milkshed, according to the usual assumptions.

This input-output curve looks superficially very different from the one for fertilizer applied to potatoes and tobacco. It also looks different from the input-output curve constructed as a result of the cooperative studies between the Department of Agriculture and the ten experiment stations (hereafter referred to as the Jensen-Woodward project), which is shown in Chart 35. The actual variation in the rate of feeding dairy

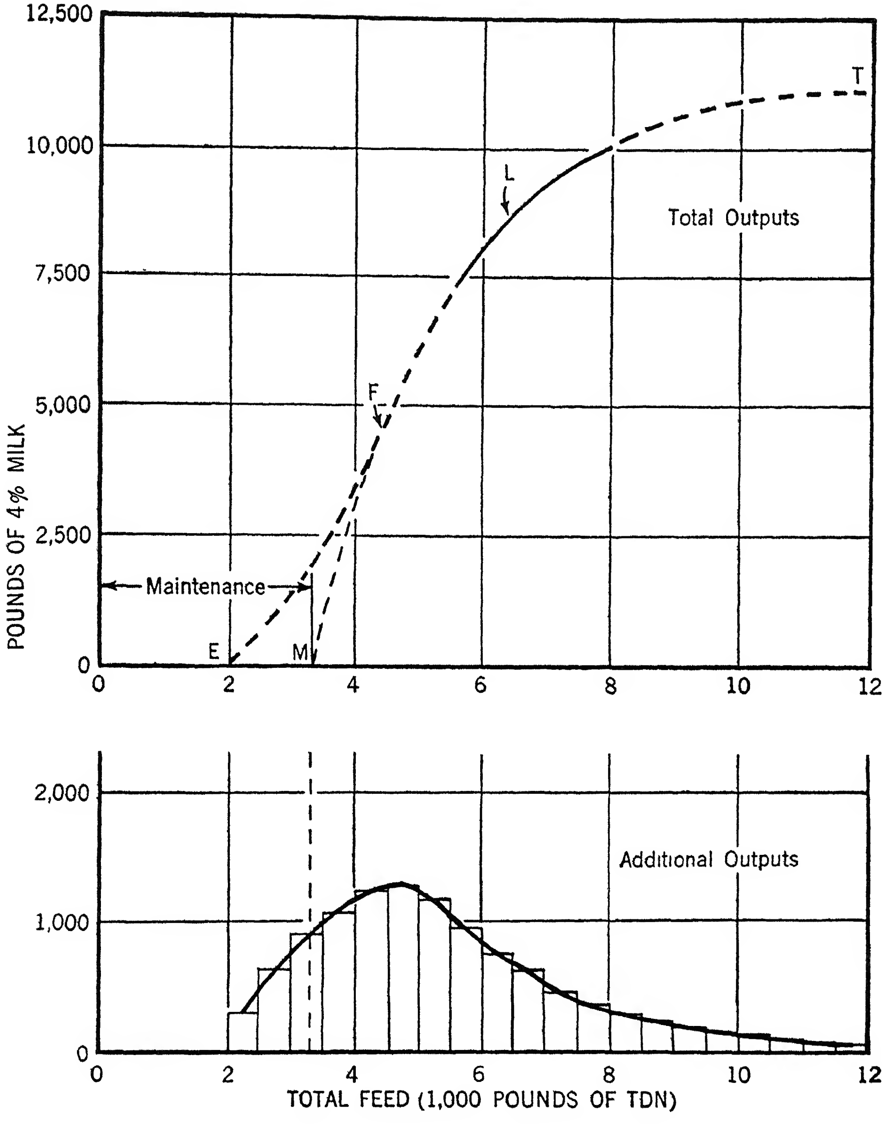

CHART 35. Relation between feed input and milk production according to results obtained with ten experiment station herds (Solid curve), and probable results at lower and higher rates of feeding (Broken curve). (Based mainly on Table 10 and Figure 13, *Input-Output Relationships in Milk Production*, by Einar Jensen, John W. Klein, Emil Rauchenstein, T. E. Woodward, and Ray H. Smith. U.S.D.A. Technical Bull. 815, 1942.)

cows in the different herds in the first two years of the experiments was only from around 5,500 to 8,000 T D N pounds.[4] The dotted portions of the curve have been extended forward and backward from these points by continuing the same relationships as appear between 5,500 and 8,000 pounds. The Point M of Chart 34 is located on Chart 35 at 3,288 pounds T D N, the maintenance ration of the cows in these herds. The Point L of Chart 34 is located at 6,250 pounds. But the output continues to increase beyond L. Although the cows reached at L the limit of their capacity to convert additional feed *all* into milk, and began to make some gain in weight, they were still adding to their milk output at 8,000 pounds T D N according to actual results obtained, and clear to 12,000 pounds T D N if we rely on the projection of the curve to Point T, which is approximately the point of diminishing total returns of economic analysis.

That the extension forward to Point T is warranted is indicated by the fact that in the third year of the experiments, the cows were given all the concentrates which they would eat and as much roughage as they would eat in addition, and still the limit of total milk output was not reached; that is, the last increments of feed added still added a little to the output. With some of the cows, the limiting factor was the amount of feed which the cows would eat, not the amount which was converted to milk.

But although these cows kept on producing more milk, the rate of increase slackened, as indicated by the curve of additional outputs in the lower section of Chart 35. The reason for this slackening of the rate of increase is that even a dairy cow is in part a meat animal. She utilizes her feed intake to maintain or increase her body weight as well as to produce milk. She will keep on eating long after the point is reached where all excess over maintenance goes into milk. Some of this excess still goes into milk, but more of it into flesh and fat. The farther beyond Point L the feeding goes, the less of it appears as milk and the more of it as meat. The change from milk to meat apparently takes place according to a curved relationship, the same as was discovered with fertilizer and plants.

At the lower end of the curve, something like the opposite of the foregoing occurs. The cow produces some milk on less than a maintenance ration, drawing upon her body for it. This is indicated by the part of the curve marked EF in Chart 35. A 1,000-pound cow that produces 1,000 pounds of 4 per cent milk will lose about 85 pounds in a ten-month lactation period if fed only a maintenance ration. If she were to

[4] The feed inputs of individual cows ranged from 4,750 to 9,590 pounds.

produce 2,000 pounds of milk in this same lactation period, she would lose 170 pounds of body weight. The Point M of Chart 34, reproduced here, is therefore a theoretical point. The actual point at which a cow exactly maintains her weight and converts feed into milk at the Morrison ratio of 0.33 pounds T D N per pound of milk is somewhere between

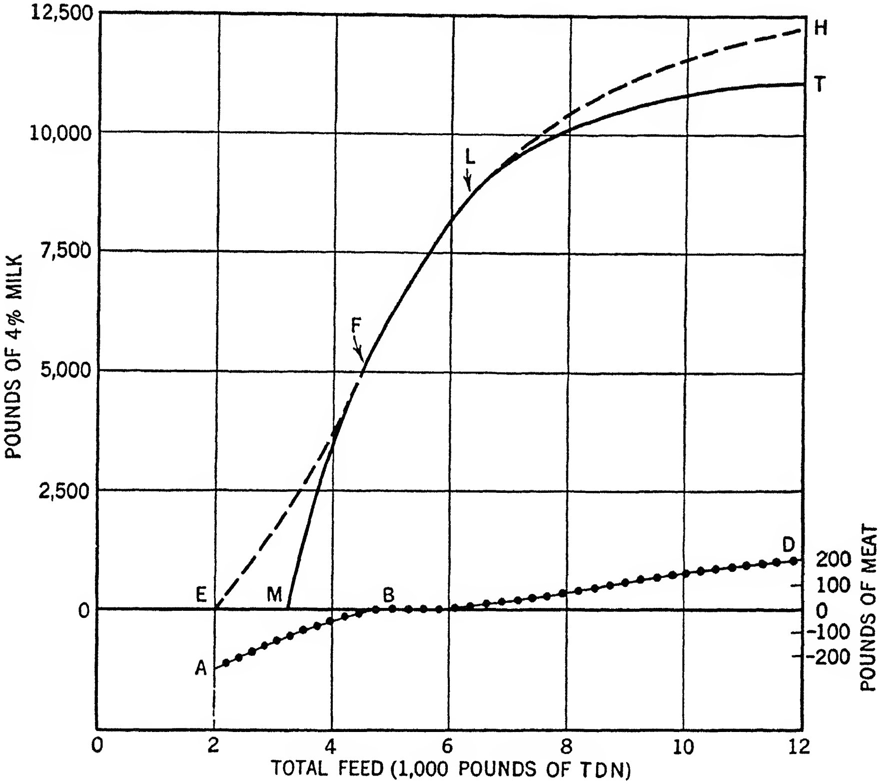

CHART 36. Relation between feed input and changes in body weight shown separately and combined with curve for milk production. The curve for weight changes is calculated from standard data on feeds and feeding.

F and L. Below F, the cow takes a little from her body to produce milk, and the farther below Point F this process is carried, the more is taken out of maintenance and converted into milk. Again this relationship takes the form of a curve. Just where Point E should be located is uncertain. No good experimental data are available on which to base the Line EF. If the one sketched in on Chart 35 is correct, the cows in these herds would produce a little milk beginning at 2,000 T D N pounds of feed.

To show these relationships properly, one really needs to combine input-output curves for milk and for flesh in one chart, as is done in Chart 36. The Curve EFLT shows the actual milk production from the varying inputs of feed; ABD the body-weight change; and MFLH the two combined. Losses in body weight subtract from the milk output up to around 4,500 pounds (Point F); add to it after 6,250 pounds (Point L). Between F and L feed goes almost wholly into milk production, and the cow's weight remains constant or nearly so. Here, then, is part of the reason that the experimental trials produced the curve shown in Chart 35 rather than the angles shown in Chart 34 — the dairy cow is still something of a meat animal.[5]

Later chapters will discuss input-output relations in the production of beef cattle, but it will be helpful here to state that if the cows were dual-purpose cows, Point L would come sooner and at a lower level of milk output. The meat Curve ABD would rise faster and higher. The difference would be still further in the same direction if the breed of cattle were Angus rather than Shorthorn.

The full explanation of the input-output curves in Chart 36, however, goes beyond this joint milk-and-meat production relationship. The combined milk-and-meat input-output relationships also take the form of a curve of diminishing additional outputs. Natural phenomena generally exhibit such a curve. Raymond Pearl, for example, found such a curve in counting the number of fruit flies that would live in a bottle on various amounts of food. There seems to be a ratio in which any input factor used in a combination makes the optimum contribution to the results. Beyond that, the contribution falls off according to some fairly constant curvilinear ratio unless disturbing circumstances enter.

HIGHEST-PROFIT FEEDING How significant these curvilinear relationships are, however, is another matter. The common rule of thumb presented to the dairy farmer for determining his rate of feeding is to use one pound T D N, in addition to maintenance, for every three

[5] The actual analysis in this case is complicated by the fact that a cow does not produce continuously as does a machine turning out nails or tin cans. From the second to the seventh month after freshening, the average cow's output falls off at the rate of 6 to 7 per cent per month. After this, the decrease becomes more rapid at something like 10 per cent for the eighth month, 15 per cent for the ninth month, and 20 per cent for the tenth month. The cow's body must be maintained during these later months and also during the period while the cow is dry. Dairy cows commonly lose weight during the early months, and then gain weight during the later months, especially if they have access to all the pasture and forage which they will eat Cows that take on weight before lactation tend to carry the effects of this over into increased milk production in the early months of the following lactation. In the Jensen-Woodward project, the whole period between two freshenings was taken as the unit of time, and the cattle were fed for two such periods and some of them for a third so as to include these effects.

pounds of milk which the cow produces. This means maintaining production at Point L, provided the cow already is being fed at that point. If the cow is being fed at a lower rate than this and the 1-to-3 rate is applied, her production will increase and this increase will become a basis for larger inputs, and so on until eventually Point L is reached. If the cow is being fed more than enough to cover her production and maintenance at Point L, and the rate of feeding is reduced back to the 1-to-3 rate, the process will move in the other direction again toward Point L. Thus, if the 1-to-3 rule is followed rigorously, all the cows in a herd will in due time be producing at Point L. Why is not this an entirely adequate solution of the feeding problem? Clearly this is the point of largest average output of milk per T D N pound, for at this point the cow's body is exactly maintained and no more, and at the same time the overhead of maintenance is spread over the largest possible number of pounds without contributing something to flesh instead of milk.

The answer is, of course, that profits are determined by prices as well as by physical input-output relations. If the cow cost nothing except maintenance — that is, if good cows were "free goods," as air is out on the countryside — and if no other costs except feed were involved in milk production, and feed and milk prices were exactly in line with each other, the problem would simply be to get the most out of each pound of feed, and that would be done at Point L. In our discussion of the most profitable rate of using fertilizer, moreover, we discovered that the price of the product and the price of the fertilizer both determine the most profitable rate of use of fertilizer, and it is obvious that the most profitable rate of feeding dairy cows will be influenced in the same way. The next step in our analysis is therefore to introduce price considerations.

The most profitable rate of feeding dairy cows, like the most profitable rate of using fertilizer, is determined by finding what increment of it, or additional output, just pays for itself. To ascertain this, the curve of total output of milk must be converted to a curve of additional outputs per additional 500 pounds T D N, or some other small unit of increment, as in the lower section of Chart 35, and the third column of Table 14. It will be noted that the curves pass through the midpoints of the rectangles that represent additional 500 pounds of feed input. These points represent approximately the average rates for the 500-pound additional inputs.[6] They represent, for example, the midpoint of the range from

[6] An accurate determination of the input-output rate at any point requires the use of calculus.

7,000 to 7,500, or 7,250 pounds T D N. In the fourth column of the table, prices have been applied to the feed used in producing the additional outputs. The prices used are those which prevailed in 1941 just before this country entered the war — $18 per ton for alfalfa, etc., as explained in the footnote of the table. These costs total up to almost exactly $2 for each additional 100 T D N pounds. This feed cost divided by the additional outputs in the third column gives the feed cost per 100 pounds of additional milk in the last column, shown also graphically

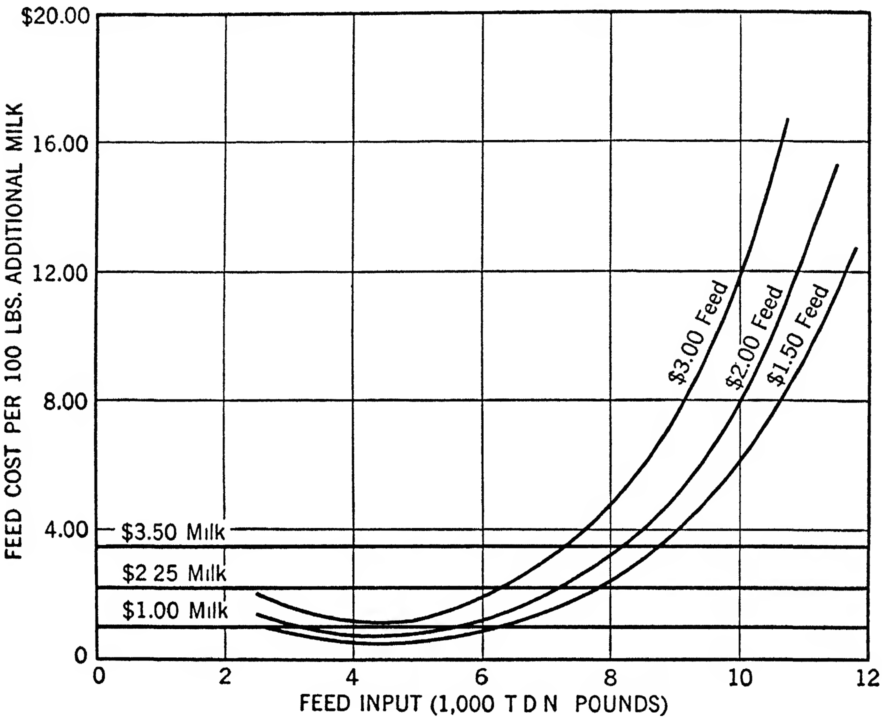

CHART 37. Feed inputs returning the highest profit at different levels of feed prices and milk prices. (Based on Table 14.)

in the middle curve in Chart 37. With feed at $2.00 per 100 T D N pounds, and milk at $3.50 per hundredweight, 8,500 pounds of feed will pay for itself and yield the largest total profit to the dairyman, assuming no other additional costs are involved. At $2.25 per hundredweight for milk, however, the highest-profit point would fall around 7,200 pounds of feed. The other two curves show how the amount of feed fed to best advantage would be changed if the feed cost $3.00 or $1.50 per 100 T D N pounds in place of $2.00.

TABLE 14. INPUT-OUTPUT RELATIONS IN FEEDING DAIRY COWS, AND THE FEED COSTS OF ADDITIONAL OUTPUTS

Total feed per cow T D N pounds	*Total milk produced per cow*	*Additional output from last 500 T D N pounds feed added*	*Additional feed cost per 100 additional pounds of milk*[a]
2,250	300	300	$ 3.33
2,750	925	625	1.60
3,250	1,825	900	1.11
3,750	2,900	1,075	.93
4,250	4,125	1,225	.82
4,750	5,400	1,275	.78
5,250	6,570	1,170	.85
5,750	7,520	950	1.05
6,250	8,300	780	1.28
6,750	8,925	625	1.60
7,250	9,410	485	2.06
7,750	9,785	375	2.67
8,250	10,085	300	3.33
8,750	10,335	250	4.00
9,250	10,535	200	5.00
9,750	10,690	155	6.45
10,250	10,815	125	8.00
10,750	10,915	100	10.00
11,250	10,995	80	12.50
11,750	11,060	65	15.38
12,250	11,110	50	

[a] For method of calculation, see text. These feed costs are based on a ration of 25 pounds of alfalfa, 2 pounds of barley, 2 pounds of beet-pulp molasses, 1 pound of bran, 1 pound of cottonseed, and 2 pounds of copra meal, with prices, at approximate 1941 levels — $18.00 per ton for alfalfa, $37.00 per ton for barley and beet pulp, $40.00 per ton for bran and copra meal, and $43.00 per ton for cottonseed meal. For simplicity's sake, the same composition of the ration has been assumed at all levels. In practice, as explained later, the cost per 100 pounds of the ration would be increased at higher feeding levels, since concentrates would be substituted in part for cheaper hay.

At the prices for feed prevailing in Los Angeles in 1941, and assuming $3.04 per hundredweight for milk, it would pay to use 7,800 T D N pounds. According to Chart 35 and Table 14 the resulting output would be 9,800 pounds of milk.

It will be of interest to test these feeding rates against the recommended rule of 1 T D N pound per 3 pounds of milk. If these cows average the same as those in the Jensen-Woodward trials, 3,288 T D N pounds of the feed would be used for maintenance. The 4,512 pounds of the production ration remaining, matched against the 9,800 pounds of milk, would give a ratio of 1 T D N pound to 2.2 pounds of milk. At this set

of relative prices, it would therefore pay to feed more than the rule. If the price of milk were to rise to $3.50 per hundredweight, according to the same analysis, 8,500 T D N pounds would pay for themselves and the 10,250 pounds of milk resulting would also represent a ratio of approximately 1-to-2.2. With feed at $2.00 per hundred pounds of T D N as in 1941, and milk down to $1.00 a hundredweight, it would pay to use only 5,200 T D N pounds. By the same analysis, this would represent a ratio of 1-to-3.4. *Hence, the rate of feeding that is most profitable does not stay at 1-to-3 or any other ratio, but varies with the relative level of prices of feed and milk.*

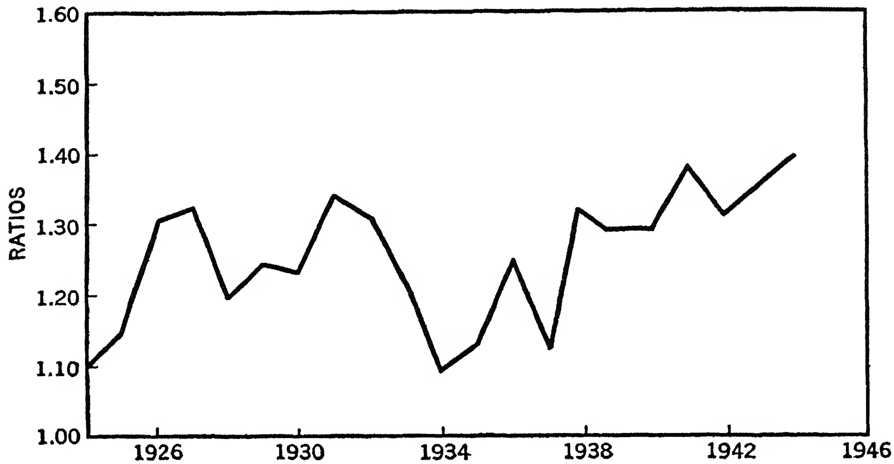

CHART 38. Milk-fed ratios, 1923–1944

However, milk and feed prices do not ordinarily get out of line as much as in the extreme cases just used for illustration. The ratio between these two sets of prices is commonly expressed in the milk-feed ratio, published by the United States Department of Agriculture, shown in Chart 38. *This ratio represents the pounds of feed that can be purchased with the price of one pound of milk.* The range between 1923 and 1944 was from 1.1 to 1.4 pounds of feed.

At $2.00 per 100 T D N pounds, the 57 per cent T D N ration used in the Los Angeles area in 1941 cost $1.15 per hundredweight of feed. A hundredweight of milk at $3.04 would buy 260 pounds of this feed. This kind of a milk-feed ratio obviously calls for a heavy rate of feeding. Labor and some other costs are high in this area, but they do not increase much with heavier feeding. Milk prices are obviously high in relation to feed prices.

The average annual milk production in the Los Angeles area is close to 10,000 pounds per cow and the rate of feeding around 7,000 T D N pounds. According to the Morrison feeding standard of 0.33 T D N's per pound of milk, 3,300 T D N pounds of feed would be required for this milk output. This would leave 3,700 T D N pounds for maintenance. But about 10 per cent must be added to this for the savings in maintenance ration resulting from culling a third of the cows within eight months of freshening. The cows must weigh 1,430 pounds to use this much feed on maintenance. Although they are dominantly of the Holstein breed, they do not average this large. It is obvious that the cows are being fed at more than the 1-to-3 rate of the Morrison standard. A ratio of 1-to-2.5 would leave 2,950 T D N pounds for maintenance, enough for cows averaging 1,130 pounds, which is approximately the average weight of the cows in this area.

The first three columns in Table 15 present the results of a statistical study of eighty-one herds in the Los Angeles area in 1939, and the last column the production, in terms of milkfat, that would be expected according to the Jensen-Woodward curves of Chart 35. It is apparent that these eighty-one herds were being fed more heavily than normal, as one would expect from the relatively high prices received for milk. However, for all levels of input except the highest, the Los Angeles herds failed to measure up to the Jensen-Woodward standards of milk output per unit of feed input; and this in spite of the saving in feed from close culling. If allowance is made for this culling, the deficiency was perhaps as much as 15 to 20 per cent.

One reason for this is the wastage of feed in commercial dairies. To make sure that each cow gets enough feed, more feed is made available than is consumed, and the difference is wasted. In the Jensen-Woodward experiments, the cows were fed individually and only the feed actually consumed was recorded. Perhaps a more important reason was that in the Jensen-Woodward project, cows were removed from the experiment when they became definitely ill. In the course of the first two years, 61 out of 259 cows were removed from the trials.[7] Those among the eighty-one Los Angeles herds which had low feed inputs were either herds not culled closely or those containing an unusual number of non-producing animals because of sickness or related factors.

In spite of these differences, however, the two sets of results are sufficiently alike to indicate that the Jensen-Woodward input-output curve can be used in the Los Angeles area as a basis for determining the rate

[7] The reasons for their removal in order of importance were Bang's disease, sterility, non-contagious abortion, mastitus, and udder troubles.

TABLE 15. INPUT-OUTPUT RELATIONS FOR EIGHTY-ONE LOS ANGELES HERDS

Inputs — T D N lbs	*Number of herds*	*Average feed input — T D N lbs.*	*Average milkfat per cow — lbs.*	*Jensen-Woodward results for same inputs — lbs.*
Under 6,500	2	6,103	302	328
6,500–7,500	10	7,134	351	377
7,500–8,500	29	7,952	396	401
8,500–9,500	32	8,882	399	419
9,500 and over	8	9,793	437	432
Average	81	8,319	393	409

Source: The data in the first four columns are from: "Report of the Bureau of Markets to the Director of Agriculture Pertaining to the Costs of Producing Fluid Milk for the Los Angeles County Marketing Area for the Year 1939." California Department of Agriculture, Bureau of Markets, Sacramento, California, 1940.

of feeding of any cow in reasonable health from one full lactation to another.

The rate of feeding dairy cows varies greatly in different sections of the United States. Production per cow is largest in the milksheds around cities and in the main dairy sections. Chart 39 indicates that the relative prices of milk and feed are closely associated with these differences in output. Feed is cheap in relation to milk in the Los Angeles milk market, and is still cheaper in some of the milksheds around the larger Southern cities. The price of feed may seem rather high to dairymen around New York, Philadelphia, and Boston, but the price of milk is enough higher to more than make up the difference. In the Corn Belt and the dairy region immediately north, both feed and milk prices are relatively low, but feed prices are the lower of the two. The highest ratios are in the border states and south into Mississippi and Texas, because milk prices are extremely low in this territory. Western Oregon and Washington present a somewhat similar balance of milk and feed prices.

COMPOSITION OF THE RATION

As the next step in the analysis of the economy of feeding dairy cows, we need to take account of the composition of the ration. Economy in rations depends upon the nutritional values of the different feeds and upon their relative prices. Feeds can be considered in terms of three major groupings — proteins, carbohydrates and fats — just as fertilizers are considered in three major groups. But fats and carbohydrates fit into the diet of the dairy cow in so nearly the same manner that they

are commonly treated as one. Consequently, the variations in the diet are expressed in terms of the ratio of protein to carbohydrates and fats combined, in the so-called nutritive ratio as already explained. The Morrison requirement of 0.060 pounds of digestible crude protein per 100 pounds of milk makes a nutritive ratio of 1 : 5.5. The nutritive ratio in the Los Angeles milkshed in 1941 was 1 : 3.7. The Los Angeles feeders are therefore supplying about 9 pounds of proteins for every 33 T D N's instead of the 6 in the Morrison standard. A ratio this rich in protein is referred to as *narrow;* one low in protein as *wide.*

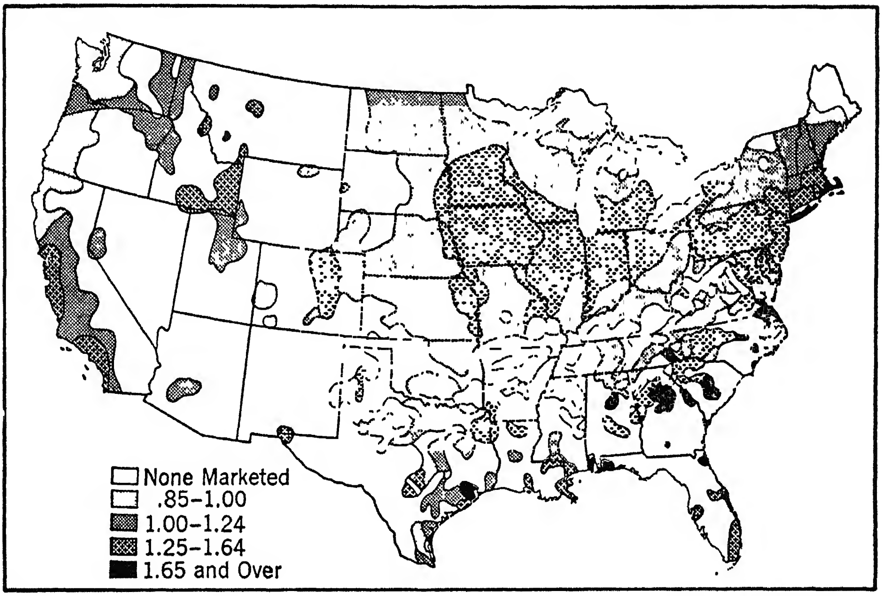

CHART 39. Milk-feed ratios by states, 1939. (Adapted from Fig. 18, U. S. D. A. Tech. Bull. 815. The pounds of concentrates, of the kinds most commonly fed in the state, that could be bought with a pound of milk containing 4 per cent fat, or the milk equivalent of milk sold as butterfat and skim milk.)

The other major variable in dairy rations is in the proportion of roughage and concentrates — the roughages including hay, pasture grass, silage, and the like; the concentrates including the grains and their by-products, cottonseed, and other oil meals, and the like. Cows will maintain their bodies and produce milk if fed wholly on roughages, but those with a high capacity for milk production cannot eat enough nutrients in this form to produce their maxima. The nearest exception to this is alfalfa hay. While alfalfa is classed as a roughage, it has about

two thirds as high a nutrient content as the common grains, and its protein content is higher than that of any of the grains. Table 16 indicates that its nutritive ratio is about the same as that of bran, but lower than that of the protein concentrates like cottonseed, copra, and linseed meal. Large Holstein cows receiving nothing but alfalfa will eat from 6 to 7 tons of it in a year. This is equivalent to 6,200 to 7,200 T D N pounds. If heavier feeding than this is desired, it must take the form of concentrates. When the roughage is predominantly silage, corn fodder, straw, or timothy hay, as in many dairy areas, the cow cannot possibly consume enough for a large output of milk.

TABLE 16 AVERAGE DIGESTIBLE NUTRIENTS FOR SELECTED FEEDS

Feed	*Total dry matter in 100 pounds*	*Digestible nutrients in 100 pounds*		*Nutritive ratio*
		DIGESTIBLE PROTEIN	TOTAL	
	Pounds	*Pounds*	*Pounds*	*1:*
Alfalfa hay	90.4	10.6	50.3	3.7
Barley	90.4	9.3	78.7	7.5
Corn, No. 2	85.2	7.1	80.6	10.3
Wheat	89.8	11.3	83.6	6.4
Cottonseed meal	93.0	37.8	80 8	1.1
Linseed meal	91.3	30 6	78.2	1.6
Copra meal	90.7	18.7	80.8	3 3
Beet-pulp, dried, molasses	91.8	6.1	74.3	11.2
Bran	90.6	13.1	70 2	4.4

Source: From Table I, Appendix, *Feeds and Feeding*, by F. B. Morrison, Twentieth Edition, 1945

In the main Jensen-Woodward experiments, the quantity of hay per cow was kept approximately constant at 3,800 to 4,000 pounds regardless of total feed input; and the quantity of silage fairly constant, within a range of 9,000 to 12,000 pounds. The quantity of grain rose from less than 2,000 to over 5,000 pounds as total feed inputs increased. In another series of experiments, however, the roughage was held constant somewhat below these levels, while the grain was varied considerably. In still another series, the cows were allowed unlimited roughage, but as the grain increased, they consumed less and less roughage.

As stated earlier, the usual daily ration in the Los Angeles area includes 25 pounds of roughage, chiefly alfalfa hay, and 8 pounds of

concentrates. The grain commonly fed to dairy cows in the Los Angeles area is barley, ordinarily grown near by in the San Joaquin or Sacramento Valleys. But corn may be shipped from the Midwest, and wheat from the Pacific Northwest. These three grains are approximately 80 per cent digestible nutrients, but their protein content is definitely lower than that of alfalfa. If these grains are substituted for alfalfa in the ration, they need to be supplemented with high-protein concentrates such as cottonseed and other oil meals. These oil meals, it will be

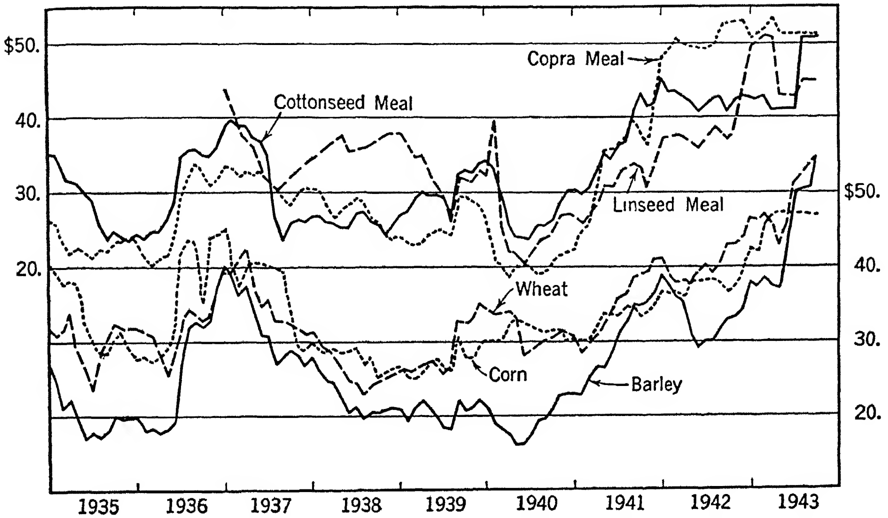

CHART 40. Changes in relative levels of prices of concentrates used in the Los Angeles milkshed, 1935–1943. (Sacked, per ton, in carlots, f. o. b. Los Angeles.)

observed in the table, have very narrow nutritive ratios, especially cottonseed and linseed. These oil meals are unnecessary when only alfalfa is fed, but are needed when grains are fed.

The discussion early in this chapter assumed, for the sake of simplicity, that the composition of the ration remains unchanged at each feeding level. Actually, more concentrates are used at the higher feeding levels. If the cow eats too much hay, she simply does not have room left for grain enough for a high level of feed input.

This introduces the problem of *balancing* the ration. If the milk-feed ratio favors an expansion of milk output, ordinarily this cannot be obtained easily without substituting concentrates for roughage in the ration and also narrowing somewhat the nutritive ratio. But as a higher proportion of grain is used, the cost per T D N rises, making a lower feeding rate the more profitable.

The usual method of balancing feeds in a ration is to compute the cost of different feeds per T D N pound of digestible crude protein, at prevailing prices, and to put together out of the cheapest of these a ration which will satisfy the Morrison or some other standard. When this is done in the Los Angeles milkshed, alfalfa is usually a cheaper source of nutrients than the grains, which in turn are usually cheaper sources than the high-protein concentrates. Consequently, the ration is composed as largely as possible from alfalfa and from grain. Chart 40 shows, however, that the relative prices of the different grains or high-protein concentrates are always changing. Barley is usually the cheapest grain, but by a varying margin. Corn and wheat compete with each other very closely. Copra meal is usually cheaper than cottonseed meal, but not always per pound of protein.

Although a dairyman needs to watch relative prices of different feeds, he should not be forever changing the composition of his rations. Both cows and hired men become accustomed to particular combinations. Only when a clear saving is apparent, and seems likely to continue for a month or two at least, should a change be made. Because he buys all his feed, the Los Angeles dairyman needs to respond to price changes more often than most other dairymen. He is in the same position as the Danish hog farmer whom the senior author visited in 1929. He was feeding his one hundred hogs on wheat from Sweden, barley from Canada, and tapioca from the East Indies. Corn was too high priced, he said. Buying feed in its cheapest form, and at favorable times in the year, are obviously important phases of management in situations such as these.

REPLACEMENTS

The other problems of management of a highly specialized dairy farm will be outlined only briefly. Either we are not far enough along in the development of our principles to handle them adequately, or else the data are not available for close analysis. Outstanding among these problems is that of herd replacements. The 90-cow farm used as our example early in the chapter buys 35 cows a year, at a cost in 1940 of $140 per head. The 30 cull cows sold for $84 per head. The net cost of the replacements was $2,380. The net cost on any one farm depends upon how several phases of the replacement problem are handled. First is buying and selecting the cows. Ordinarily, they must be purchased on the basis of inspection without benefit of production records. Some of the cows are bought in areas as far away as southern

Idaho. Judgment in selecting cows can easily mean the difference between success and failure in such an enterprise. Second, not knowing the capacity of the new cows brought into his herd, the operator has to discover it by trial and error. Then comes the problem of how long to keep any cow. Ordinarily, no dairyman in the area will buy a cow culled by another dairyman. Sale at any time subsequent to purchase is at a loss, just as with a new automobile once it has left the hands of the dealer. If this initial loss is spread over a longer period, the initial depreciation becomes less important; but as the cow nears the end of any lactation period, it will be two or three months before her production will rise again, and it will not pay to keep her unless she is a reasonably good producer. Thus, the replacement of the cow and the time of disposing of her is an individual problem for each cow.

If more were known about differences in the inherent capacity of the cows purchased in this area and about the rate of aging, a chart could be constructed showing the effect of rate of replacement upon total milk production, and costs and outputs could be balanced against each other. At one end of the scale would be a low rate of replacement such as is found on farms where fairly young cows are purchased and milked until they are well past their prime. At the extreme right would be the farms which buy cows in their prime and cull at any time during the lactation period that the milk production falls below a high standard. Replacement policies ranging widely between these extremes are followed on the different farms, and these differences partly account for the variations in output per unit of feed appearing in Table 15.

Rate of replacement and rate of feeding and composition of the ration are to some extent interrelated — the heavier the feeding and the narrower the nutritive ratio, the sooner the cows pass their prime, and the more likely they are to have udder troubles. The evidence on these points is not very clear, but the actual experience of dairymen has led many of them to believe that forcing their cows too much does not pay.

OUTPUT AND SELLING PRICES

With the best possible adjustment of supply to demand, some milk is produced for city markets that has to be used as cream. This means that it is sold at a price that competes with cream shipped from lower-cost areas. Actually, milk output commonly runs ahead of fluid milk consumption, so that perhaps as much as 10 to 40 per cent of it sells at the lower price. This reduces the average or *blended* price to the pro-

ducer. Production and price are therefore closely tied together within the milkshed. If the producers distribute their milk direct to consumers, as a small fraction of them commonly do, they find their blended prices varying inversely with their output, and try to keep their output closely adjusted to their sales of fluid milk. If they sell to distributors, the distributor has to adjust his payments to his volume of fluid milk sales. If the producers are members of a cooperative, the cooperative collects from the distributors on the basis of milk used for fluid consumption, milk used to produce cream, and perhaps some milk even made into butter at seasons of high production, and divides the proceeds among the members. The method of sale therefore does not change the fundamental output-and-price relationship.

LABOR

The labor-management problem of the dry-lot dairy farms of the Los Angeles milkshed is not one of labor distribution — the labor load is more uniform than in most factories. Rather, it arises from the insistency of the needs of labor. Such a farm must have a labor staff that it can depend upon day after day. Not only must the cows be fed and milked each day, but because of the stringent health regulations, all the work with the milk must be done with care. The amount of labor can be varied to a limited extent, however, by omitting a few of the less essential tasks. A statistical array of labor inputs per cow will show a range that reflects something more than efficiency in the use of labor.

The most obvious way of increasing milk production by the use of more labor is to milk the cows three or four times daily rather than twice. The additional output adds to the production ration about as indicated in Chart 35, but not to the maintenance ration. It may also increase replacement costs a little. The additional milk obtained in this way would ordinarily be cheap milk except for the extra labor involved. The extra labor expense if hired labor is employed is commonly too large in this country to justify extra milkings except in some milksheds. The improvements in machine milking now under way may change this situation greatly in the next ten years.

Particularly in the Los Angeles area on the larger farms, some specialization by tasks has developed. Some of the workers do nothing but milk. On some of the farms, the milkers leave the stripping to be done by someone else. However, there is very little standardization of jobs in the area and many different combinations of jobs are found on the different farms in the milkshed.

SCALE OF PRODUCTION

Some of the principles involved in size of farm business are well illustrated by these specialized dairy farms, as we shall have occasion to point out in Chapter XIX. It should be made clear at this point that the farms in this area are not really as large as their gross receipts indicate. A dairy farm with 45 cows which produces most of its feed and replacements may be a larger business than a 90-cow dry-lot farm. Nevertheless, these specialized dairy farms are well above the average in size, and the reasons for this are important.

It should also be pointed out, however, that smaller family-size farms tend to persist in considerable numbers, and not to become any larger than a family can handle, because of the fundamental economy of combining this kind of farming with family living. The young people in the family can go to school and still help with the milking and chores morning and night. A sharp break seems to occur between the farms that operate with their own labor supply and those which must hire a full-time man to help with the milking and feeding.

FURTHER READING

* Einar Jensen, John W. Klein, Emil Rauchenstein, T. E. Woodward, and Ray H. Smith, *Input-Output Relationships in Milk Production,* U.S.D.A. Tech. Bull. 815, 1942.

F. B. Morrison, *Feeds and Feeding*, Twentieth Edition, Ithaca, Morrison Publishing Co., 1945.

* National Research Council, *Recommended Allowances for Dairy Cattle*, Report of the Committee on Animal Nutrition, Washington, D. C., 1945.

* Arthur Shultis, *Dairy Farm Management in California,* California Bull. 640.

EXERCISES

1. At what price per bushel is barley as economical a feed as corn at $1.00 per bushel, if only T D N's are considered? If only protein is considered? At what price per ton is copra as economical a source of protein as cottonseed meal at $40 per ton?
2. Using the concentrate prices shown in Chart 40, and assuming alfalfa prices at $18 per ton and maximum alfalfa consumption per cow at 6 tons, calculate the most economical ration in mid-1940 for a total feed input of 6,500 pounds T D N. For 9,500 pounds T D N.
3. Disregarding other costs, and assuming that roughage costs the same per T D N as concentrate, calculate the most profitable rate of feeding, with milk selling at $2.00 per hundredweight, in several of the areas in Chart 39.
4. Are there any livestock farms in your home county that are about as specialized as the dry-lot dairy described in this chapter? If so, describe the organization of one. Why does it exist here?

CHAPTER X

Diversified-Crop Farms

THE SYSTEMS OF FARMING CONSIDERED IN THIS CHAPTER OBTAIN THEIR incomes mostly from two or more crops instead of one. They therefore introduce the principles of farm management having to do with determining the most advantageous combination of enterprises. To present and apply these principles is the main object of this chapter. But first let us get a few facts in mind as to the organization and distribution of these diversified-crop farms. Mainly they fall in three groups: the cotton, tobacco, and peanut combinations of the South; the cash-grain farms of the Corn Belt and eastern Great Plains; and the cash-crop combinations of the irrigated valleys of the West.

COTTON-TOBACCO-PEANUTS The farms which most nearly answer the description of a diversified-crop farm are found in the part of the United States shown in Chart 41, particularly in the four shaded areas. In the Tidewater, Coastal Plains, and Lower Piedmont areas, less than 12 per cent of the cash income in 1929 was derived from livestock, including poultry. Cotton, tobacco, and/or peanuts are grown on most of the farms in all these areas. In the Lower Piedmont, the tobacco-cotton combination is dominant; in the Tidewater area nearer the coast, the peanut-cotton combination. The adjoining type-of-farming areas shown on the map include on the north the one-crop Piedmont tobacco area which we studied in Chapter VIII, and the specialized Virginia peanut area. The area to the west produces too much livestock to be classified as crop farming, although one or more of the three crops are found on all the farms. The areas adjoining the seacoast are either devoted to truck crops, potatoes, or fruit production, or are in woodland or swamp. All of this part of the United States is devoted much more largely to crop, fruit, and truck growing than to livestock production, and only two of the areas practice single-crop rather than diversified-crop farming.

Only in one other part of the South is the farming so definitely of the

diversified-crop type as in this Virginia-Carolina section, namely, in the Coastal Plain section of southern Georgia, inland from the Flatwoods section, and south of the Georgia Peach area, in which specialized peach or cotton farms are dominant. Cotton, tobacco, and peanuts

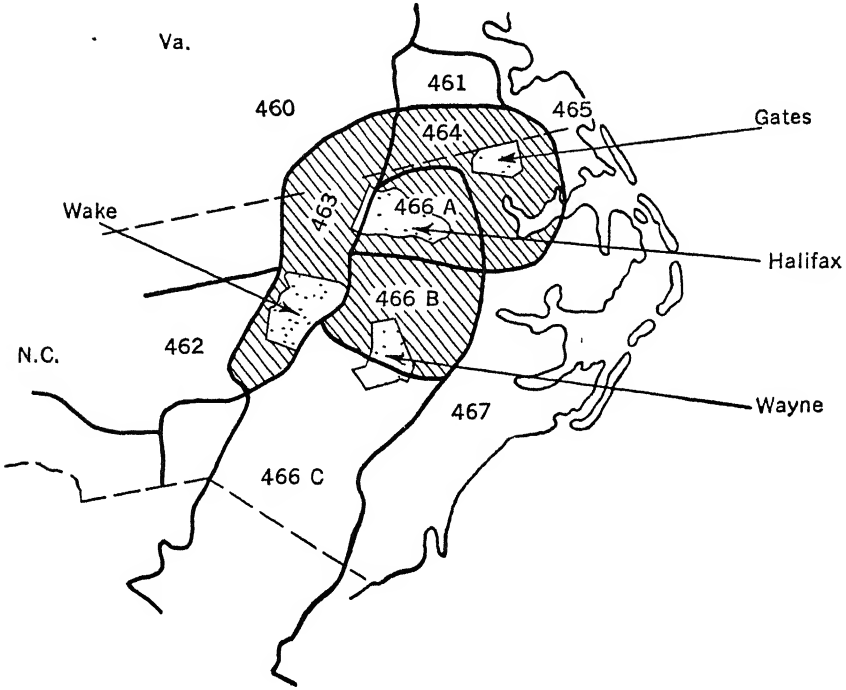

CHART 41. The diversified-crop type-of-farming areas of North Carolina and Virginia, and four selected counties.

Shaded Areas	*Adjoining Areas*
463 Lower Piedmont — tobacco, cotton	460 Piedmont — flue-cured tobacco
464 Tidewater — peanuts, cotton, some tobacco	461 Virginia peanut area
466A Coastal Plain — tobacco, cotton, peanuts	467 Tidewater — tobacco and truck
466B Coastal Plain — tobacco, some cotton	462 Piedmont — cotton, some tobacco, and livestock
	465 Norfolk — truck and potatoes

are the main crops here also, with sweet potatoes sometimes in the combination, and sometimes pecans. Peanuts are more important here, and westward into Alabama, than in any other area in the South.

The sweeping changes in agriculture during the decade of the 1930's reduced the cotton acreage almost a half. The tobacco acreage also declined in the specialized tobacco areas. The land thus released went into corn more largely than into any other use. More land also went

into forage crops, and the number of dairy cows increased about a half in the more northern of these areas. The numbers of hogs increased about a third in the Lower Piedmont and Tidewater areas. The peanut acreage increased in the Lower Piedmont and at least held its own in the other parts of this territory. The wartime changes tended in the same general direction, but with more emphasis on peanuts. But by 1944, the grain-fed livestock enterprises had contracted considerably.

We will be able to discuss the management problems of these farms better if we have in mind the principal facts about their organization, reported for 1929 in Table 17. In all of these counties except Halifax, more of the farms are classified as *crop-specialty* than as *cotton*. This means that more of their income is from tobacco and peanuts than from cotton. In Halifax County, all but 8 per cent of the farms fall in one or the other of these classes; in Wayne, all but 12 per cent; in Wake, all but 15 per cent. In Gates and Lowndes Counties, however, one third of the farms are of other types, principally *general*. This means that not enough of the income came from cotton, or from tobacco and peanuts combined, to add up to 40 per cent of the total income. These particular farms had more miscellaneous crops, such as sweet potatoes and truck crops.

The farms in all these counties have values of product well under the national averages. In general, the cotton farms have lower values of product than the crop-specialty farms. Tobacco returns a larger value per crop acre because of the large amount of labor employed in growing it. Measured in terms of labor input, the farms combining tobacco with cotton are larger than those producing cotton only, though smaller in some cases in terms of crop acres. The incomes of these farms are derived, as on the flue-cured tobacco farms already studied, from intensive labor, largely hand labor, on small acreages of crops. The corn grown on these farms is nearly all used as feed for mules and humans. These farms average less than one cow per farm, including both dairy cows and beef cows, and scarcely one sow or gilt. The principal income from livestock is from the sale of a few eggs.

CASH-GRAIN The cash-grain areas of the Midwest are so designated to distinguish them from the areas in which most of the grain is fed to livestock on the same farms. Once they were overwhelmingly cash-crop areas like those which we have been considering in the Southeast, but this is no longer true. They are best described as areas in which considerable of the grain is still sold for cash, and in which a considerable fraction of the farms sell nearly all their grain. Our concern in this chapter is only with this latter fraction of the farms in these areas.

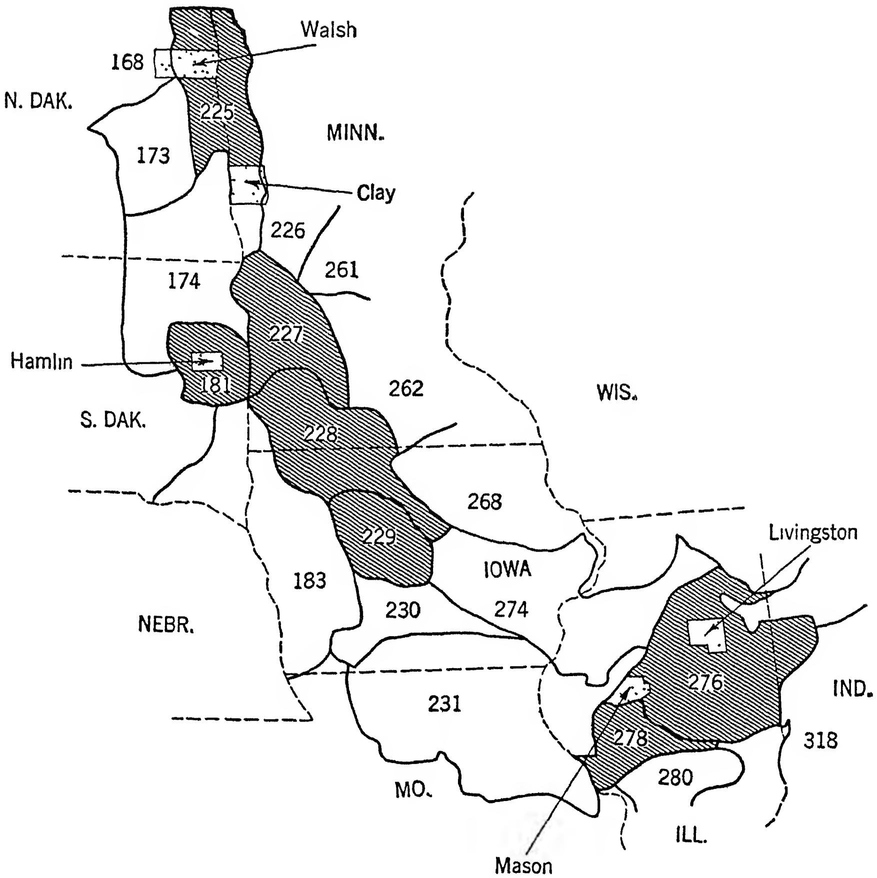

CHART 42. Cash-grain areas of the Midwest, and the five counties in Table 18.

Shaded Areas

225 Red River Valley — cash grain, potatoes, dairy
227 W. Central Minn. — general, cash grain, livestock, dairy
181 Brookings, S. Dak. — livestock, cash grain
228 S.W. Minn. — livestock, cash grain, general, sugar beets
229 N. Central Iowa — cash grain, livestock
276 Illinois-Indiana — cash-grain area
278 S.W. Illinois — cash grain, livestock, general

Adjoining Areas

168 & 173 N. Dak. Black Prairies — cash grain (wheat), livestock
174 N. Dak.–S. Dak. — cash grain (wheat), livestock, general
183 Iowa–Neb.–S. Dak. — hogs and beef cattle
226 N.W. Minn. — dairy, livestock, cash grain, potatoes
268 N.E. Iowa — livestock, dairy
274 Iowa–Ill. — livestock, cash grain
230 S. Iowa — livestock
231 Mo.–Iowa — livestock, general
262 S.E. Minn. — dairy, general
280 S.W. Ill. — general, dairy, cash grain
318 Central Ind. — livestock, general, cash grain

3 per cent in potatoes. Taking all farms in this northern area together, more than a third of the farm income came from livestock. The livestock fraction is larger now than then. The part of the territory which is in Illinois derived over half of its income in 1929 from the sale of corn, oats, and wheat for cash, and only about a fourth from livestock; but the trend has been toward livestock here also. In Area 181 in the center of this territory, the grains grown are a mixture of those of Areas 276 and 225, barley and spring wheat being combined with corn and oats.

.This cash-grain territory is mostly bordered by areas in which half or more of the grain is fed to livestock — in east central Iowa and eastward into Illinois, to beef cattle and hogs; in southwestern Minnesota, to dairy cows also. In northern Minnesota, the livestock are nearly all dairy cows. To the west in the Dakotas, the shift is toward wheat, and wheat and range cattle. From 1930 to 1940, wheat growing gave way somewhat to grazing on the Plains, or the wheatland was simply allowed to grow up to weeds and very thin stands of grass. After 1942, much of this land was planted to wheat again. But cattle numbers were also large because of the excellent rainfall in the years following 1940.

Table 18 gives the organization facts about five selected counties in this Midwest region. Three of these are predominantly cash-grain farming areas. In Clay County, however, the 8 per cent of the land in potatoes returns 32 per cent of the income, and the wheat crop only 17 per cent of it. Walsh County, just across the river and a little north, has less than one half as much of its land in potatoes as Clay County, and three times as much in wheat. All the counties on the west side of the Red River grow much more wheat and less barley and oats than the counties on the east side of the river. The Dakota counties have from 3 to 5 per cent of their land in flax. The farms classified as crop-specialty in three of these counties combine potatoes with small grain, and in Clay County the potatoes are dominant. The cash-grain and crop-specialty farms in these counties get about all their income from crop sales, and in three of the counties most of the farms are of this description. Two of the counties, Clay and Hamlin, however, have more *general* farms than diversified-crop farms. This means that the farms do not obtain as much as 40 per cent of their income from cash grain or from potatoes, but some income from one or both of these, and also sizable amounts from their herds of dairy or beef cattle. The next most numerous type of farming in these two counties is dairying. The other counties on the North Dakota side run about like Walsh.

Central Iowa is not represented in the table. Webster County would represent this area well. Two thirds of its farms are classified as cash-

grain, about one fourth as animal-specialty, and most of the rest as general. On these farms, two thirds of the income comes from crop sales, and this would be true generally for cash-grain farms in central Iowa. These cash-grain farms in 1929 had gross incomes of $3,400. However, in the county as a whole, about as much of the income is

TABLE 18. THE ORGANIZATION OF DIVERSIFIED-CROP FARMS IN SELECTED COUNTIES IN THE MIDWEST, 1929–1930

	Ill.–Ind. Cash-grain	*Ill.–Ind. Cash-grain*	*Red River Valley*	*Brookings S. Dak.*	*Red River Valley*
Type number of area	276a	276b	225c	181	225d
Combination	Corn Oats	Corn Oats Wheat	Wheat Barley Oats Potatoes	Corn Oats Barley Potatoes	Potatoes Oats Wheat Barley
Percentage of land in area in:					
Crops	81	78	79	76	78
Pasture	16	11	16	18	16
Corn	41	29	1	16	5
Oats	26	7	9	17	13
Barley	—	—	13	13	12
Wheat	3	24	26	4	9
Hay	5	5	10	11	14
Potatoes	—	—	2	—	8
County	Livingston Ill.	Mason Ill.	Walsh N. Dak.	Hamlin S. Dak.	Clay Minn.
Number of farms in county	3,570	1,371	2,483	1,175	2,087
Cash-grain farms:					
Number	3,106	1,061	1,788	309	186
Value	$32,600	$20,920	$11,460	$17,294	$16,300
Acres	195	231	345	300	276
Crop acres	166	171	230	227	209
Value of products — total	$3,790	$3,080	$2,710	$2,400	$1,930
Crop sales	2,700	2,180	1,940	1,420	1,340
Livestock sales	400	340	180	420	170
Livestock product sales	450	275	280	310	215
Products used by family	282	284	303	250	213
Crop-specialty farms:					
Number	0	8	281	79	551
Value			$12,260	$15,613	$13,170
Acres			284	264	287
Crop acres			197	200	211
Value of products — total			$4,980	$4,240	$3,260
Crop sales			4,230	2,830	2,370
Livestock sales			210	710	15
Livestock product sales			290	450	360
Products used by family			270	260	324

derived from livestock as from the sale of cash grain, and in surrounding counties the livestock income is generally the larger. About 40 per cent of the land is in corn, 30 per cent in oats, and 5 per cent in hay. Thus, although there is much diversified-crop farming in central Iowa, it is as much a livestock as a crop-farming section.

The cash-grain farmers of the Midwest were among those most adversely affected by the depression in the early 1930's, and among those which benefited most from the A A A program. At the same time, the introduction of the general-purpose tractor, the small combine, the corn picker, hybrid seed corn, the expansion of soybeans, the increased use of lime, and the seeding of alfalfa and sweet clover on land held out of grain production, had a pronounced effect on cash-grain farming.

Until the war, although the A A A programs encouraged the growing of more forage crops, part of these were plowed under as green-manure crops. The relatively high grain prices and favorable corn loan rates kept many farmers from expanding their livestock production very much. At the same time, corn yields increased because of the use of hybrid seed, improved tillage practices, improved crop rotations and favorable weather. As a result, corn production on most of these farms was higher in 1937–1940 than in any similar period since corn was first cultivated. This corn was stored on the farm as security for government loans, or delivered to the government as payment for loans and stored in steel bins and grain elevators by the government.

Equally important, the A A A program permitted soybeans to be grown interchangeably with oats, and since soybeans yield a higher value of product per acre than oats, their acreage expanded rapidly.

The war increased the price of meats relative to grains, and hog and poultry production expanded at once, and continued to do so until the grain in storage was all fed out or used in making alcohol. Also, when the Pacific supplies of vegetable oils were cut off, the government undertook a vigorous program for the expansion of soybeans and flax. The soybean acreage increased sharply in the southern part of the Midwest cash-grain areas. At its peak, many diversified-crop farms in Illinois had larger acreages of soybeans than of oats, and on some farms the soybean acreage exceeded that of corn. In 1942, Illinois had almost half as large an acreage of soybeans as of corn, and a slightly larger acreage of soybeans than of oats. Farther north — in northwest Iowa and in the Red River Valley area — many farms grew increased acreages of flax during the war. These shifts to soybeans and flax, however, did not reduce the corn acreage. Instead, it increased a little. The development of high-yielding varieties of oats may reverse these changes.

As a result of the changes from 1933 to 1940, plus those induced by the war, many farms which were essentially diversified-crop farms in 1929 are now diversified-crop-and-livestock farms, with a substantial income from the sale of livestock and livestock products as well as from grain crops. Many farm families are also now renting additional land and are operating larger units than before the introduction of the general-purpose tractor, combine, and corn picker.

WESTERN AREAS The diversified-crop areas of the Mountain and Pacific states are usually in little pockets mostly of irrigated land. They tend to be unusually diversified. Thus, one in Idaho combines potatoes, sugar beets, field peas, and wheat. Another combines field beans with potatoes and cash grain; another, sugar beets with beans, truck crops, and fruit. Usually, however, not all of these are found on the same farms. Alfalfa is grown in combination with the foregoing crops in the north, and with cotton in the south. When livestock is combined with the crops, as in many of these areas, to provide a use for the hay and the by-products of crops such as sugar beets and peas, the farming becomes diversified-crop-and-livestock.

Bonneville County, Idaho, may be taken as an example of diversified-crop farming in a northern irrigated valley. Sixty per cent of the farms in this county were classified as crop-specialty in 1930, and cash grain was the next group in importance. The others are a mixture of mostly general and animal-specialty farms. The cash-grain farms averaged 600 acres, and the crop-specialty farms only 100 acres. Thus, the cash-grain farms consist largely or wholly of adjacent dry land, and the crop-specialty farms mainly of irrigated land. Around 90 per cent of the income of the cash-grain farms was from crops, and 80 per cent of the income of the crop-specialty farms. For the county as a whole, about 40 per cent of the cropland is in alfalfa or other hay, 30 per cent in wheat, 7 per cent in potatoes, 6 per cent in dry peas, 4 per cent in sugar beets, and 3 per cent in oats. The income from potatoes and/or sugar beets bulked much larger in the total in 1929 than these acreages suggest, but 1929 was a year of very high potato prices.

The diversified-crop farming areas in the Southwest are very small pockets in the midst of arid lands, and data for whole counties are not very helpful. Yuma County, Arizona, for example, in which Area 71 is located, was reported as having 460 cotton farms and 70 crop-specialty farms in 1929. In the part of the county designated as 71, however, more of the farms were crop-specialty farms producing alfalfa hay and seed than were cotton farms.

The organization of these diversified cash-crop farming areas in the West has changed little since 1930. By 1940, they were keeping a little more livestock, especially dairy cows, and in several areas the sugar-beet acreage had expanded. Sugar-beet acreage had been at a rather low point in 1929 because of diseases. The acreage-control programs no doubt checked the expansion of sugar-beet growing. The changes during the war were mostly back toward more emphasis upon cash crops, including potatoes and beans. Sugar-beet acreage has increased only in a few areas, mainly because of shortages of labor and the high prices of competing crops.

OTHER DIVERSIFIED-CROP SECTIONS Scattered over the country are a good many small areas with a preponderance of farms which derive the major portion of their income from two or three crops. The combinations may include one or more of the following: tobacco, potatoes, sugar beets, alfalfa, dry beans or peas, canning crops, grass or clover seed, as well as major crops like cotton, corn, and wheat. Other areas that appear to combine two crops — perhaps sugar cane and cotton, or cotton and rice — mostly grow these on different farms. Some of the more important of these combinations are discussed in the chapters in Part Five on special types of farming. Thus the chapter on Sugar and Specialty Crops will consider the sugar-beet combinations.

The wheat-cotton combination, however, had best be discussed briefly in this chapter. Wheat and cotton are combined on the same farms over a rather wide range of counties in western Texas and reaching up into Oklahoma. In much of this territory, however, enough livestock is combined with the wheat and cotton to make the farms diversified-crop-and-livestock farms. Hale County, Texas, may be taken to exemplify the area in which cash-crop income is dominant. In this county, only one sixth of the farm income is from livestock, even though 40 per cent of the 350 acres in the average farm is in pasture. Four fifths of the farms were either cash-grain or cotton farms in 1929, the cash-grain farms being somewhat the more prevalent. The cash-grain farms were nearly twice as large as the cotton farms, and averaged $4,400 of product as compared with $2,500 for the cotton farms. Wheat occupied 32 per cent of the land, grain sorghum 19 per cent, and cotton only 5 per cent. Between 1930 and 1940, the wheat and cotton acreages of Hale County were reduced a half. The acreage of grain sorghum, in turn, increased from 96,000 to 132,000. These two groups of farms averaged only ten head of cattle per farm in 1929. In 1940, they had about fifteen. In the cotton-wheat area as a whole, about 40 per cent

of the income was derived from wheat in 1929, around 25 per cent from cotton, and 25 per cent from livestock. To the south and east, cotton becomes the more dominant crop; and to the west, wheat, until grazing and livestock ranching replace crop production.

WHY CROPS ARE COMBINED

The central management problem of diversified-crop farms, it is now apparent, is what crops to combine in what proportions. But first of all we need to answer the question as to why more than one crop. There are several answers, as follows:

1. The labor, workstock, and equipment are idle too much of the time if only one crop is grown. The product of a farm comes from the labor and equipment used upon it as well as from the land. If more months of productive labor can be found, the income is larger. Hence, single-crop farmers are always looking for something to do that will earn them some income at slack periods. The obvious way of doing this is to plant another crop that uses labor during the periods of the year when it is not needed for the main crop. Crops which can be fitted into the farm operations in this way are said to *supplement* the others in the use of labor and equipment. They make possible a *fuller use* of it. This relationship between products is referred to in economics as *supplementary*. The crops that use labor or equipment at the same periods are said to *compete* for this labor and equipment, and the relationship is referred to in economics as *competitive*. Thus, corn and oats are largely supplementary in the use of labor and equipment because they are planted and harvested at different periods. Spring wheat, oats, and barley, in contrast, are largely competitive, since they are all planted and harvested at about the same time.
2. The fertility of the soil is kept in better balance if two or three crops are grown in succession. Different crops make different demands on the plant nutrients in the soil. Legume crops, in addition, transfer atmospheric nitrogen from the air to the soil. Deep-rooted crops such as alfalfa and sweet clover also draw plant nutrients from layers of soil not usually tapped by shallow-rooted grain and root crops and store part of these in the heavy root growth near the surface. They also improve the soil structure. Close-growing forage crops reduce erosion and add much-needed organic matter when they are plowed under. Before the value of legumes was known, European farmers allowed land to lie idle for a year to regain its productive

capacity. Or, for a hundred years or so just before the legumes came in, they alternated root crops with the grain instead of a year of fallow, having discovered that the land was as productive after root crops as after fallow.

3. The crop may not only fill a vacant or idle period in the rotation, but it may help the other crop or crops. The oats crop used as a companion crop for clover or alfalfa keeps down the weeds and allows the clover seedlings to grow up under the partial shade it affords. The clover crop which follows adds nitrogen to the soil, which is an important contribution to the corn crop which usually follows in rotation. The cultivation of the corn crop in turn kills off the weeds and leaves the land in condition to be fitted readily for oats or winter wheat. A winter crop also keeps the land covered and prevents erosion of the soil. When one crop helps out another in this way, the relationship is referred to as *complementary.*
4. A farm is more certain of an income each year if it does not depend on one crop alone. The potato growers of Maine who rely upon only one crop suffer severely from adversities of weather and price. If they could fit some other crop, like field peas or even winter wheat, into their cropping system, they would have more regular incomes. The farmers who grow both cotton and tobacco are less in danger of an all-around bad year than those depending upon one or the other.
5. Continuing use of a piece of land for the same crop will often result in serious losses from diseases. Reductions in fertility can be counterbalanced with commercial fertilizers, but soil-borne diseases in numerous instances make the rotation of crops imperative.
6. Many farms have a variety of types of land and soil conditions which are better utilized if several crops are grown, each best adapted to a particular soil. Thus a farm consisting partly of irrigated and partly of dry-farming land can be fully utilized only if grain is grown on the one and irrigated crops, like alfalfa or potatoes, on the other. In our analysis of one-crop flue-cured tobacco farms in Chapter VIII, we discovered that the best cropping system called for selecting certain fields and using them in a special tobacco, winter oats, and redtop rotation, and using a corn, wheat, and lespedeza rotation on the other fields. The acreage of tobacco on many farms in the border states is determined by the few acres of suitable land available. The income from these few acres, in turn, saves the farmer from having to cultivate his steep hillsides.
7. Some farms can raise two or more crops a year on the same land. This is particularly true in the South.

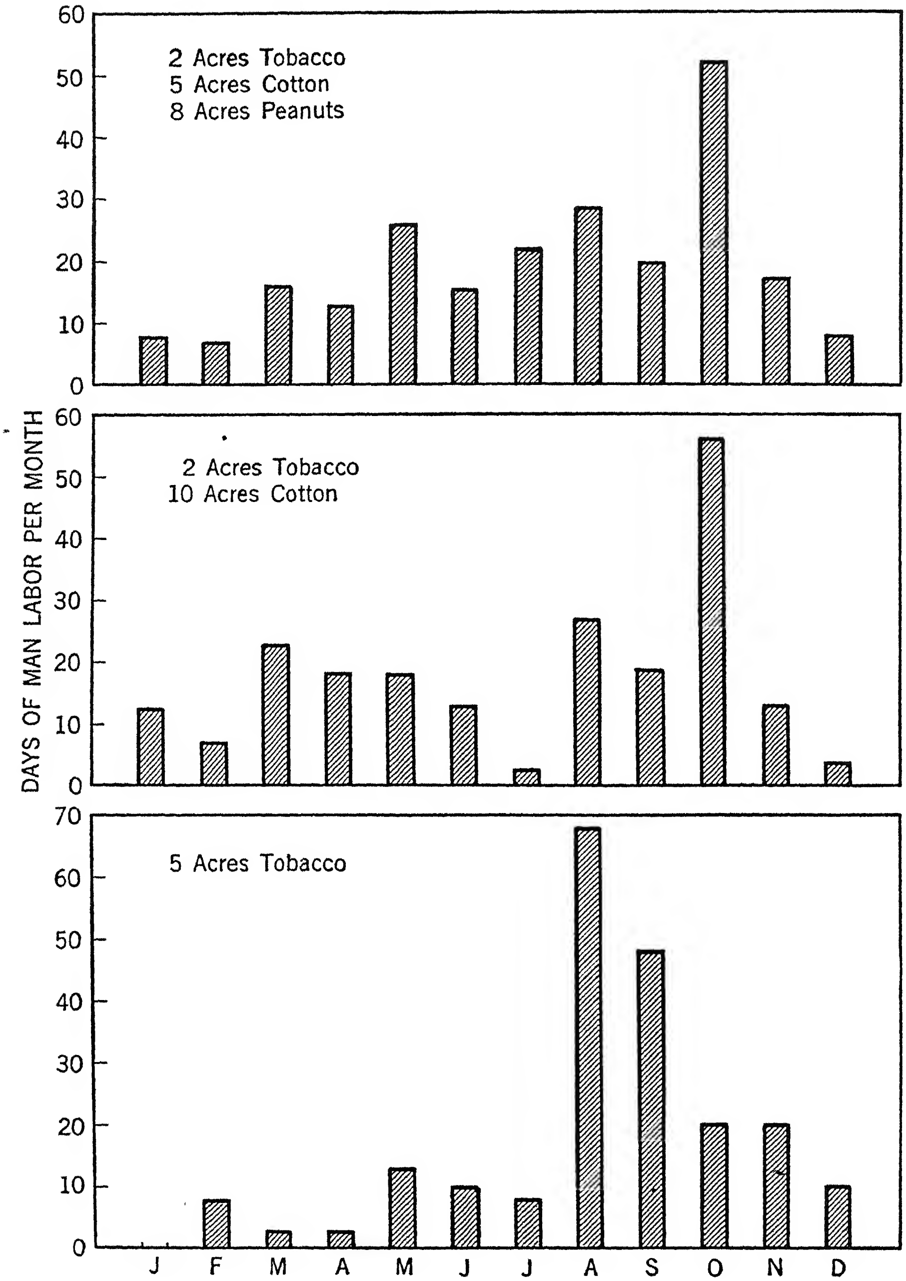

CHART 43. Labor distribution on a tobacco farm, a tobacco-cotton farm, and on a tobacco-cotton-peanut farm in North Carolina.

DISTRIBUTION OF LABOR USE Some of the foregoing relationships need to be examined more carefully. This can best be done in terms of the diversified-crop systems that we have just been considering. Chart 43 shows how the distribution of labor on the flue-cured tobacco farm analyzed in Chapter VIII would be changed if 10 acres of cotton were substituted for 3 of the 5 acres now in tobacco; also how it would be changed if 8 acres of harvested peanuts plus 5 acres of cotton were substituted for the same 3 acres now in tobacco. These three cropping systems use approximately the same amount of labor, but distribute its use very differently. The two-crop system provides a considerably more even distribution of the labor load than the one-crop system; and the three-crop system pretty well levels out the work load except for the one month of October. With the first system, the family is not busy at all except during four months, although it has some corn and hay crops to tend to; but it can provide fuller employment for itself in the other eight months only by farming a good bit of additional land and hiring much labor in August and September. Only a little additional land and a little hiring would provide nine months of fairly full employment under the third system.

Corn and oats, and corn and winter wheat, fit together with virtually no overlapping in the use of labor. The corn, however, needs much more labor than the small grain. Consequently, the diversified cropping systems with a high proportion of corn do not provide an even distribution of labor use. Much of the corn picking in the Corn Belt has therefore been done in the past by extra labor on a piece-rate basis. With increasing use of corn pickers, the fitting of the land and the planting become the bottleneck.

Growing both oats and barley, or both oats and spring wheat, improves a little the labor distribution on a northern cash-grain farm because these grains do not ripen exactly at the same time. Unfortunately the climate of most of the small-grain areas of the United States does not favor the combination of winter grains and spring grains as in western Europe, although winter rye is used in this way to a limited extent.

In addition to the labor needed for crop production itself, a farm always has a certain amount of repair and upkeep work that can be done in the slack seasons of the year. No amount of fitting together of crops alone, however, ordinarily provides year-round work on a farm. Livestock enterprises, we will observe in the chapter following, are needed for this. The hours of work spent on the livestock enterprises added may not earn as much per hour as those spent on the main crops, but they still add greatly to income.

USE OF POWER AND EQUIPMENT The peak loads of power and equipment use on crop farms come at planting and harvest time in the same way as for labor. Horse and mule labor, and tractor work on larger farms, are therefore distributed about the same as man labor. The more diversified the cropping system, therefore, the fuller the use of animal and tractor power and equipment. This simple statement does not, however, reach the major problems connected with the full use of power and equipment. Full discussion of these is reserved for Chapter XXIV, which deals with the management of farm machinery and equipment. It will be helpful, however, at this point to state some of these problems as they arise on diversified-crop farms.

1. Even general-purpose equipment, like general-purpose tractors, wagons, trucks, plows and harrows, are in use much less of the time than man labor. General-purpose tractors are ordinarily used around 600 to 800 hours per year on Corn Belt farms; and the average horse around 900 hours per year on farms without tractors, and 300 hours on farms with tractors.
2. Much of the equipment, like grain binders, combines, and field hay balers, has a very limited use at the best. It therefore needs to save a great deal of labor in the short period while it is in use if it is to reduce costs.
3. The smallest-sized machine now available, and in many cases, feasible to operate, has more capacity than millions of our smaller farmers need. Yet the tendency is for each farmer to want his own expensive harvesting machinery — corn picker, potato digger, or combine. Small farms, for this reason, are likely to have excessive machinery investments. Joint ownership, or custom hiring, are enough cheaper to offset its disadvantages on most small farms. The war caused a large increase in custom work on farms.
4. Many of the tasks performed by both the general- and the special-purpose machines need to be done quickly in years of unfavorable weather. Hence, farmers are inclined to buy larger machines than they need in ordinary years, thus adding further to their overhead costs.
5. Most farms have many tasks for which a general-purpose tractor large enough to meet the foregoing needs is cumbersome and expensive to operate. They therefore either keep a horse or a team for such work or use their big tractor for all sorts of minor jobs. This difficulty is now being met on some of the larger family farms by using a combination of a three-bottom tractor and a small tractor. The small tractor is used for light field work and for hauling which

otherwise would be done by the big tractor or by two or four horses. This small tractor also provides extra capacity in unfavorable seasons. Farms equipped in this way have no use for horses. Few farmers with tractors have disposed of all of their horses, but they are doing so increasingly, especially on crop farms.

Improvements in tractor, tillage, and harvest equipment have done much to reduce the amount of labor that must be used along with the machinery. From 1909 to 1936, the average man-hours used per acre of wheat in the Corn Belt declined from 16.4 to 11.7; and in the small-grain area, from 9.8 to 4.2. Comparable figures for the average acre of corn in the Corn Belt are 22.0 and 16.9. Developments in combines and mechanical corn pickers and their more general adoption since 1936, have further reduced the labor inputs in harvesting wheat, corn, and especially soybeans. The farm operator with the help of one hired man in the crop season can handle up to 300 acres of cropland in the Corn Belt. Mechanization has made much less headway in much of the South. Cotton, tobacco, peanuts, and most early vegetables still use large amounts of hand labor for harvesting and on many farms for cultivation. Peanuts in the Southwest are now being plowed out, windrowed with side-delivery rakes and picked without stacking, and it is only a question of time before mechanical cotton pickers will be widely used.

THE USE OF THE LAND Although two or three crops in rotation exhaust the plant nutrients in the soil more slowly than one-crop farming, they do it very effectively in time, especially if the land is kept in row crops. When crops are sold off the farm, the plant nutrients entering into them go with them.

The diversified-crop farms of the Midwest are found on its most productive soils. They have been farmed only for a short span of years as compared with the fields of Europe, or for that matter, the older agricultural producing areas of the South. Yet they show evidences of overcropping in many sections, and soil specialists agree that the continued practice of growing only such crops as corn, soybeans, and oats on these farms will not maintain the productivity of the soil at its present high level. However, rotations which will do this have been developed and are now widely used. They combine legume crops, mainly red clover, alfalfa, and sweet clover, with the corn and small grains. The red clover and alfalfa are commonly cut for hay, and the hay is either sold or fed to livestock. Red clover fits into most farming systems without competing seriously with other crops for labor and machines. Alfalfa, however,

has to be cut at least three times during the summer and competes seriously with the corn cultivating. Sweet clover is often seeded in the oats and plowed down the following spring when the seedbed is prepared for corn. The only additional cash cost is the price of twelve pounds of seed per acre. The shifting of the time of plowing from fall until spring increases the load of spring work, but with the improved power and machinery now available, this is not a serious drawback.

When the soybeans now grown increasingly in the Midwest are intertilled, they allow as much or even greater soil erosion than corn. When broadcast, they leave the land bare over the winter. They usually replace oats rather than corn, and as a result more than half of the rotated land in some sections is exposed to erosion year after year.

The winter-erosion and soil-depletion problems of many parts of the South are being met in large part by seeding winter cover crops such as vetch and Austrian peas, after the cash crop has been harvested or between the rows of cotton at the last cultivation. As already pointed out, more than one crop can be grown on the same land each year in much of the South. It is possible to produce a good crop of winter oats and to follow it with a cultivated crop. This means an additional drain on the land, which needs to be offset by green-manure crops. Many farms, however, do not have power enough to turn the green manure under quickly if the spring is wet. Also, the fall-seeded grain crops often suffer from a lack of rainfall during August and the early part of September. Winter grain and legumes must get a good start during this period if the yields are not to be very small and the soil-building benefits from the legumes extremely low in consequence.

DETERMINING THE MOST PROFITABLE CROP COMBINATION

In analyzing farms with only one crop or one livestock product, the major problem of management was the combination of the factors of production — land, fertilizer, seed, labor, equipment, etc. — that would return the largest profit. In analyzing multiple-crop farms, this analysis must be made for each of the crops, *but in addition an analysis is needed to determine the most profitable combination of these crops.* The management of a diversified-crop farm, therefore, offers all the problems of a one-crop farm multiplied by the number of crops, plus the problem of combination of crops. It is no less difficult to manage the tobacco that is part of a tobacco-cotton farm than it is to manage the tobacco on a farm that grows nothing else. And likewise for cotton or peanuts. The new

problem is that of determining the combination of the crops that will return the largest net income.

THE COMPARATIVE ADVANTAGE PRINCIPLE The general principle of economics involved in this problem of combination of crops is the familiar *principle of comparative advantage*, but with a *special application.*

This principle is ordinarily taught in terms of competing areas specializing in one product. It affirms that an area will specialize in producing that product in which its ratio of advantage is greatest. The phrase *ratio of advantage* calls for a *two-way comparison*, of the *relative advantage* of the products competing in *any one area*, with the *relative advantage* of the products in the *competing areas*. Thus, it involves determining the advantage of cotton, tobacco, and peanuts, produced on one-crop farms, in a particular area in North Carolina — Halifax County, for example; likewise, the *relative advantage* of these three crops in Lowndes County, Georgia. True *comparative* advantage is not determined until these two sets of relative advantages are compared with each other to determine in which the *ratio of advantage* is the greater for cotton, for tobacco, and for peanuts.

Of course, these comparisons are not restricted to two areas — all the areas in which each of these crops has possibilities are always being compared in this way. Usually, however, a few of them have such clear advantage that the others are out of the running. And how much of each product is wanted is also important. If only a little flue-cured tobacco is wanted, its price will be so low that only the one area with the very highest ratio of advantage will grow it, whereas if the demand is large, the price will be high enough to bring several less-advantaged areas also into its production.

We are now ready for the special application of the principle of comparative advantage that is required in diversified farming. *When crops are grown in rotation, cropping systems must be compared instead of single crops.* Thus in Halifax County, the relative advantage of growing all tobacco, of growing 2 acres of tobacco plus 10 acres of cotton, of growing 2 acres of tobacco plus 5 acres of cotton plus 8 acres of peanuts, and of any other likely combination, are compared; and similarly for Lowndes County and other competing areas. Then the relative advantage setups of the competing areas in terms of these cropping systems are compared to get their ratios of advantage. Of course the relative demand and prices of the three products will determine in how many competing areas a particular cropping system is followed.

A few statements are needed here as to what determines the compara-

tive advantage of cropping systems. The usual statements run in terms of climate, soil, distance from market, labor supply, and managerial ability and skills. *To these must be added in diversified farming the complementary, supplementary, and joint-product relationships between products or enterprises.* If cotton and tobacco together provide a fuller use of the family labor, this becomes as important a basis for comparative advantage as climate or soil; similarly, for corn and oats in the cash-grain area of Illinois-Indiana. Though oats may not yield as well in Illinois as farther north, their supplementalness in the use of labor, equipment, and land, and their complementalness as a nurse crop for clover, may give a corn-oats cropping system a clear advantage over any other. The joint product cottonseed may be important in determining the advantage of a cropping system including cotton; similarly the joint-product relationships between peanut hay and shelled peanuts in determining the comparative advantage of cropping systems including this crop.

MEASURING COMPARATIVE ADVANTAGE Although it is important for a farm operator to understand how the principle of comparative advantage determines what cropping system prevails in his area, and what factors give this system its advantage, he has a greater need for a method of analysis that he can apply to his particular farm. He needs this in part because comparative advantage varies from farm to farm due to differences in soils, topography, land types, location, labor supply, and the like; in part because varieties of crops, machines, methods of control of insects and disease, and cultural practices are constantly changing comparative advantage; and in part because the relative prices of the competing crops are always in a state of flux. Several methods of analysis are in common use; let us examine them individually.

A. *Gross Return per Acre.* From the standpoint of total volume of business conducted on the farm, the gross receipts per acre are significant; but they do not show comparative advantage directly because they do not take account of the differing amount of expense connected with the competing crops.

Let us see how this and other measures work out on an actual farm — a cotton-tobacco-peanut farm in Lowndes County, a part of the southern Coastal Plain of Georgia. Table 19 shows that the sales from these three cash crops in 1942 were \$1,500, \$632, and \$585 respectively. These made up 86 per cent of the gross receipts, not counting in the value of the produce consumed by the farm family. Table 20 shows that the gross returns per acre for tobacco, cotton, and peanuts in 1940 were \$267, \$54, and \$62 respectively.

TABLE 19. ORGANIZATION AND INCOME, COTTON-PEANUT-TOBACCO FARM, COASTAL PLAIN, GEORGIA

Land use	*Acres*	*Yield per acre*	*Livestock*	*Number*
Cotton	27.0 (lint)	240	Mules	4
	(seed)	400	Cows (milk)	2
Tobacco	2 3	890	(beef)	2
Peanuts (dug)	10.0 (nuts)	900	Sows	1
Peanuts (grazed)	2 0 (hog feed)	700	Hens	40
Corn	25 0	12 5 (bu.)		
Peanuts (in corn)	25.0 (grazed)			
Oats and vetch	3.0 (grazed)			
Oats	3 0 (hay)	1,400		
Cowpeas (single-cropped)	3.0 (hay)	1,500		
Cowpeas (after oats)	6 0 (hay)	1,500		
Garden	1.0			
Idle cropland	7.0			
Pasture	7.0			
Pasture	36.0			
Total acreage	157.3			

Receipts	
Cotton (lint) at 19.3¢ per lb.	$1,254
(seed) at $45.50 per ton	246
Tobacco at 30.9¢ per lb.	632
Peanuts at $130 per ton	585
Cattle (beef) at $9.20 per cwt.	125
Hogs at $11.90 per cwt.	218
Poultry at 19¢ per lb.	52
Eggs at 21¢ per doz.	26
Other	36
Total receipts	$3,174

B. *Net Cash Returns per Acre* — that is, returns after out-of-pocket expenses are deducted. These are $235, $45, and $51 per acre respectively. This farm, it would appear on the surface, ought to grow just as many acres of tobacco as it can with the labor and equipment it has available if it wants to increase its income. Every acre of tobacco that can be substituted for an acre of cotton would appear to add $190 to the cash farm income. But the family may already be handling all the tobacco it can at the times of the year when tobacco needs care.

C. *Net Cash Returns per Hour of Labor.* Surely the fact that an acre of tobacco used 575 hours of labor, as shown in Table 20, whereas cotton used only 77, and peanuts only 64, must be taken into account. Per hour of labor, the net cash returns were 41, 59, and 80 cents respectively. The peanut enterprise would appear to pay best on this basis; but it

would take 21 more acres of peanuts to utilize the labor now used on the 2.3 acres of tobacco, and this would not leave much land for cotton and corn. The peanuts would also use much more mule labor and equipment than the tobacco, for these tend to be proportional to land.

TABLE 20. RETURN PER ACRE AND PER HOUR, FROM THE FARMING OPERATIONS OF TABLE 19

	Tobacco	*Cotton*	*Peanuts for digging*
Production	890 lbs.	lint, 240 lbs seed, 400 lbs.	nuts, 900 lbs. hay, 1,000 lbs.
Price per unit	30	lint, 18.5¢ seed, 2.3¢	nuts, 6.5¢ hay, 0.4¢
Gross value	$267.00	$53.60	$62 50
Out-of-pocket expenses:			
Seed	$1.00	$1.00	$2.40
Fertilizers	$21 59	$4.90	$2.50
Other[a]	$8.89	$2.28	$6.52
Total	$31.48	$8.18	$11.42
Return above out-of-pocket costs	$235.52	$45 42	$51.08
Hours of labor per acre[b]	575	77	64
Net cash return per hour of labor	41¢	59¢	80¢

[a] No extra labor was hired for any crop.
[b] Computed for farms using two-mule equipment.

It is obvious that no one of these measures is adequate, though each throws some light on the problem. Their main shortcoming is that they do not take account of the times of the year when the labor is used on the different crops. These different crops use labor partly at the same time and partly at different times. This is highly important from the standpoint of the farm income. Let us consider three different possible situations under this head:

a. Where the crops use labor during exactly the same weeks throughout the year, so that the more of one crop that is grown, the less that can be grown of the other. In this situation, the crop will be chosen which gives the highest net return per acre *if land is the scarce factor*,

and per hour of labor *if labor is the scarce factor* (and no more of either can be rented or hired). This is a highly unrealistic case. Yet it is only in such a case that net returns per acre and per hour give the final answer.

b. Where the crops use the labor and equipment at altogether different times of the year, with no conflict among them. In this case, the crop with the largest return per hour should be expanded to the point that it uses all the labor available when this crop can use it. The land that is left should be devoted as far as possible to the crop that comes nearest to this in return per hour of labor, until all of the labor available in its working time is fully utilized. A third should be fitted in if some land remains that could not be used with the first two crops. In actual practice, the farm family might prefer to include a third crop so as to distribute its labor load more evenly over the year, preferring to sacrifice a little income to escape from long hours on the other two crops. It is obvious, also, that this is an unreal case. Rarely are crops completely nonconflicting in the use of labor.

c. Where the crops compete at one season of the year but not in another. This is the realistic situation. Take the case of tobacco and cotton: the starting of the young tobacco plants in seedbeds comes in the late winter and does not really conflict with cotton. The preparation of the land for tobacco and the planting of the tobacco comes after the corn and cotton planting, but interferes somewhat with the care of the young cotton and corn crops. The harvesting and other fall work of the tobacco comes on ahead of the cotton, but is ordinarily not completed when it is time to begin harvesting the cotton. Similarly, oats and corn do not conflict in planting time, but the oats harvest runs into the end of the corn cultivating and haying. To expand the one of the two crops conflicting at harvest time which gives the largest return per acre may mean that there is little work to do at the planting time for the other crop, and as a result the labor will not be as fully employed during the year, and the net farm income will be reduced.

In some situations, however, the alternative of hiring additional labor at a peak-load period may be available, making it possible to expand an enterprise requiring labor at that time. The net return after paying for this peak-load labor may not, however, be increased. Another alternative may be to rent or buy additional land that can be used to expand the acreage of peanuts or cotton and thus spread the available farm labor over more acres. This is an alternative that is likely to be adopted increasingly as tractors come into more general use in the South.

Other factors that these three measures do not take into account are differences in demands on the soil of the competing cropping systems. It is well understood that the peanut crop when harvested draws heavily upon the plant nutrients in the soil. One of the crops may also have important complementary values. These factors are very evident in the cash-grain farming of the Corn Belt. Records on a group of farms in central Illinois show the following net cash returns in 1943 for five crops commonly included in cropping systems there: [1]

	CORN	OATS (*combined*)	SOYBEANS	ALFALFA HAY	CLOVER HAY
Returns per hour of labor	$ 4.76	$ 2.22	$ 4.76	$ 1.05	$ .50
Returns per acre	52.80	15.82	34.79	23.05	9.92

Although the corn and soybeans show the same net returns per hour of labor, the corn ranks much higher than the soybeans per acre of land. Of the three grain crops, oats shows the least return on either basis. Yet, because the oats crop serves as a companion crop to new hay and pasture seedings, or to sweet clover used for green manure, the net income for the farm as a whole would be reduced if corn and soybeans were grown in place of the oats. This is equally true for red clover, which shows the lowest return of all.

D. *Net Returns per Acre, All Costs Deducted.* An attempt is often made to improve upon net returns data of the foregoing sorts by deducting estimated cost charges for man labor, animal labor, equipment, etc., and adding allowances for by-products and complements. The resulting figures are often said to show the *relative profitableness* of the different crops. Such figures, if they could be obtained, would more nearly provide the final answer as to the most advantageous cropping system than the A, B, or C measures. But they require some difficult estimates on diversified-crop farms. The biggest difficulties come in distributing the cost charges of the man labor and mule or horse labor over the different crops. Surely it is not correct to charge the same rate for labor used in starting a seedbed in February as for labor used in harvesting the tobacco in August, because in February the labor has very little other use whereas in August it is in great demand. If any return at all can be obtained for labor in February, it may be worthwhile. When uniform man-labor, animal-labor and equipment rates are charged to all crops regardless of the time of year, those which use these at slack seasons usually show low net returns. The oats enterprise usually fares this way in the Corn

[1] Adapted from *Illinois Farm Economics*, September, 1944.

Belt. Yet if the oats crop is dropped, the farm income is reduced unless some other crop can be found that does not compete with the corn. Soybeans only in a measure meets these requirements. At the same time, the crops using labor and equipment at peak periods appear to earn too much per acre. If farms are reorganized on the basis of such figures, their net incomes are likely to be reduced rather than increased.

If net return figures are to be obtained which are really net, moreover, they must include allowances for differences in the drain on the soil of the crops in the rotation, for the value of crop by-products to the rest of the farm, for the value of complements such as nitrogen from legumes, and for the values of protection of the soil against winter erosion and of protection for grass and clover seeding. Such figures, if they could be worked out, would show the actual net returns per acre for each of the crops. But rarely have net returns estimates of this sort been compiled that can be taken at their face value as safe guides to reorganizing the cropping systems of diversified farms. Most of them apply flat rates to all labor regardless of season, and fail to place values on complements.

Even if such estimates were reasonably accurate, they frequently would not point the way to the changes needed. They would not show, for example, how the net returns would be changed if more soybeans were in the future substituted for corn, or more peanuts for cotton. As computed, they are historical figures showing the results in the combinations and with the methods followed in the preceding or some earlier year. A shift to a new cropping system with more soybeans or peanuts might give significantly different net returns. Or a change in cultural methods might affect the comparison greatly.

E. *Net Returns to the Farm Business as a Whole.* The final test of the validity of any measure of comparative advantage of cropping systems is the effect on the net income of the farm business. If adding or subtracting any crop, like peanuts in a cotton-tobacco combination, reduces the net income, it should be ruled out; likewise, a change in the proportions of tobacco and cotton on a tobacco-cotton farm that reduces the net income. As pointed out in Chapter V on "The Ends of Farming," this test should not be applied too narrowly. The short-run and the long-run answers may be different — a particular price situation in any one year or short series of years may make the combination with more cotton or tobacco more profitable. A larger money income may also be obtained for a year or two by drawing heavily on soil reserves. This may be warranted if the nation is at war, or if the particular farmer is in great need of additional income for a year or two. But the real income

is not increased, for the farmer is merely using up some of his capital. The combination would not appear to be the more profitable if the extra drain on the soil were really subtracted as an expense.

Let us first apply this test to the cash-grain farm in central Iowa presented in Table 21. This farm has a tractor, a corn picker, and a combine, and hires no labor. The only out-of-pocket costs in growing soybeans and corn are seed and the fuel, oil, and repairs for the tractor. Seed corn costs only about $1.00 an acre. The other costs of corn and soybeans are 84 cents an acre; and of oats, only 50 cents an acre. The gross returns per acre for the corn, oats, and soybeans are $57, $24, and $33 respectively. The net returns per acre are in roughly the same proportions.

TABLE 21. THE ORGANIZATION AND INCOME OF A CASH-GRAIN FARM IN CENTRAL IOWA, 1943

Land use	*Acres*	*Yield per acre*	*Livestock*	*Number*
Corn	70	60 bu.	Horses	2
Oats	50	40 bu.	Milk cows	4
Soybeans	20	20 bu.	Other cattle	1
Mixed hay	10	1.5 tons	Chickens	100
Permanent pasture	10			
Total	160			

Receipts		
Corn, 3,900 bu. at 95¢	$3,705	
Oats, 1,775 bu. at 60¢	1,065	
Soybeans, 360 bu. at $1.85	666	
Butterfat sales, 400 lbs. at 50¢	200	
Eggs, 400 doz. at 30¢	120	
Total receipts		$5,756

It would appear superficially that this farm would earn most, at least in the short run, if planted entirely to corn, at the relative prices in 1943. If this were done, however, enough equipment and labor would be required to fit the land and plant the whole acreage in a few weeks in the spring, and cultivate it in June and the first week in July. Then there would be nothing further to do until harvesting time, when the crop would need to be harvested within a few weeks. The farmer's labor force and machinery would therefore be idle much of the year. Besides, within a few years the yields would begin to decline as the soil deteriorated and corn diseases and pests multiplied. It might well be that if labor could be hired for the peak-load planting and harvesting periods, the one-crop corn farming would pay the best on this farm for a few

years; but certainly not in the long pull. Unfortunately, no data are available that can be used in testing out this last statement thoroughly.

Assuming then that corn is to be grown in rotation, let us consider some possible alternatives. One of these might be to shift 30 acres from oats to soybeans. This would mean two extra days of tractor labor in the spring, and increase the competition for labor and equipment at that time, even though soybeans are usually planted a little later than the corn; likewise the competition in the fall, although the soybean harvest begins a little sooner. The same combine would harvest the soybeans as the oats, but four days of extra harvesting labor would be needed in the fall. The extra out-of-pocket expense entailed by the shift is $35. The following is a comparison of the current net cash returns to the farm business, under the present and suggested systems, at 1943 prices and yields, assuming no soil losses from increased erosion, and the same amounts used for feed, and the same receipts from other sources. The farmer would need to decide whether the extra $345 per year warranted the risk of soil losses, and the extra days of labor for himself and family helpers spring and fall.

PRESENT SYSTEM

	Value above out-of-pocket expense
Corn, 70 acres at 60 bu.	$3,705
Soybeans, 20 acres at 20 bu.	666
Oats, 50 acres at 40 bu.	1,065
Other receipts	320
Current net cash income	$5,756

ALTERNATIVE NO. 1

	Value above out-of-pocket expense
Corn, 70 acres at 60 bu.	$3,705
Soybeans, 50 acres at 20 bu.	1,766
Oats, 20 acres at 40 bu.	345
Other receipts	320
Total	$6,136
Extra expense	35
Current net cash income	$6,101

Alternative No. 2, analyzed in similar manner below, reduces somewhat the labor burden in the spring and fall, and is a little easier on the land, but it decreases the current net cash income by $200. Alternative No. 3 increases the labor load in the spring and fall, and yields decline somewhat presently — the evidence is clear that corn and oats both yield a little more with soybeans in the rotation than without. Corn yields are also reduced because the corn planting is stretched out over a longer period. This can be offset by using larger equipment, but the net returns might be reduced still more in consequence. The labor hired to help with the harvesting of 30 more acres of corn adds $45 to the cash expenses.

ALTERNATIVE NO. 2

	Value above out-of-pocket expense
Corn, 60 acres at 60 bu.	$3,135
Oats, 50 acres at 40 bu.	1,065
Soybeans, 30 acres at 20 bu.	1,036
Other receipts	320
Current net cash income	$5,556

ALTERNATIVE NO. 3

	Value above out-of-pocket expense
Corn, 90 acres at 54 bu.	$4,332
Oats, 50 acres at 37 bu.	974
Other receipts	320
Total	$5,627
Extra expense	45
Current net cash income	$5,582

None of the suggested alternatives except the first, therefore, promises to increase the net cash returns to the farm business, and this probably not enough to offset the accompanying disadvantages in the long run. At some other set of relative prices, however, or with new developments in technology, the answer might be different.

These farm analyses are not detailed budget analyses such as worked out for the cropping systems on potato and tobacco farms in Chapters VII and VIII. They are instead summaries of such analyses, substituted here only to save space. A farmer ordinarily needs to work out the details whenever he sets out to test the organization of his farm. Usually some of the information which he needs for this is not available. This is most likely to be true of data on the effects of rotation systems on yields in the longer run.

It should now be apparent that a farmer does not need to know the net returns, with all costs deducted, from the different crops in a rotation, or the "relative profitableness" of these crops, in order to determine his cropping system. Instead, he is interested in the relative profitableness of alternative whole-cropping systems. Specifically, he wants to know which whole-cropping system will give him the largest net income, currently, and in the longer run. To answer this question, he has no need to undertake the difficult tasks of distributing man-labor costs, animal-labor costs, and equipment costs over the different operations in different months of the year crop by crop. Neither does he need to place values upon by-products and upon the complements of one crop to another. Data on gross and net returns per acre and per hour are suggestive, but they do not give the final answer needed.

If the authors had chosen to use the cotton-tobacco-peanut farm described in Table 19 to illustrate the analysis of alternative cropping systems, they would have had not only to present detailed budget analyses, but complete farm organization plans. Such a farm is likely

to have two or three different rotation systems suited to its different types of land. The Iowa farm analyzed is practically all of one land type and all in one rotation system. In most parts of the Southeast, the harvest time for tobacco precedes the harvest time for cotton. Small grains are fall-sown in the South and harvested at a slack time during the summer. They therefore have highly desirable supplementary relationships with most of the cash crops in much of that region. Cotton and peanuts compete for labor and machinery during the early spring and again in August and September; but by careful choice of varieties, substantial acreages of these crops can be grown on the same farm, if extra labor can be hired in the peak-load period of cotton picking and peanut digging. Cotton and corn are highly competitive during the early spring months, and also at cultivation time. Usually the work on the corn is delayed until the cotton is tended.

A Red River Valley or southwestern Minnesota farm might also have exhibited a complex pattern of rotation systems, including in some cases potatoes or sugar beets along with small grain, corn, and alfalfa or other hay crop. The central Illinois-Indiana farm would have included more soybeans or wheat or both and less oats, and the conclusions would have been greatly influenced by the longer-time effect of soybeans on the soil.

A final observation needed at the end of this discussion of combination of enterprises is that although farmers need to consider very carefully the best combination for their farms and to be on the alert for needed changes, the general framework of the plan is likely to remain the same for long periods. The year-to-year changes in the plan of operation ordinarily amount to nothing more than modification of the long-term plan in line with anticipated price-cost relationships for the coming year. There are definite limits within which such changes can be made without affecting the basic organization of the farm. These limits arise mainly from the types of relationships which have been described above. For example, when winter grains have been introduced primarily to supplement cash crops such as cotton and peanuts, it will not be profitable to increase the grain enterprises beyond what can be taken care of with present animal or tractor power.

FURTHER READING

* W. L. Gibson, Jr., *An Economic Study of Farming in Appomattox County, Virginia*, Virginia Bull. 311, 1937.
* W. E. Hendrix, Charles P. Butler, and Kenneth V. Goodman, *Peanut Production Possibilities in Georgia*, Georgia Bull. 228, 1943.

EXERCISES

1. Are there diversified-crop farms, generally similar to those described in this chapter, in your home county? What crops do they raise, and in what proportions?
2. Compute, for the crops grown in such combinations, the *gross cash returns per acre*, if the crops are all sold, at current prices. Also compute *net cash returns per acre* in the manner indicated in the chapter. Finally, compute the *net cash farm income* for the farms as wholes.
3. Compute some approximate figures for net cash returns per hour of labor for the different crops. Compare these with the net cash returns per acre and explain the difference.
4. Explain, on the basis of the foregoing analyses, why the different crops persist in these combinations.
5. Set up some summary comparisons of net cash farm incomes, like those in the last section of the chapter, for different alternative proportions of the cash crops in the combinations.
6. List the crops commonly grown on the same farms in your section of the state, and the times of the year when they compete for labor.
7. Outline for each crop commonly grown in your section of the state the cost items to be included in calculations of net cash returns per acre.

CHAPTER XI

Feed-and-Livestock Farms

THIS CHAPTER AND THE ONE FOLLOWING WILL CONSIDER THE MANagement problems of farms which dispose of the feed which they produce by converting it to meat or livestock products. These are to be contrasted with those considered in Chapter X which sell their crops for cash and with those considered in Chapter IX which buy most of their feed. Some of the farms analyzed in these chapters, especially the dairy farms, buy a fraction of their feed. Others buy some of the pigs, lambs, or young cattle which they fatten with the feed produced on their farms. The essential character of these farms, however, is that they devote their land to forage and feed crops and sell these in the form of meat or livestock products.

The census has no classification of farms that coincides with the feed-and-livestock farms of this chapter. Farms of this description appear under two heads in the 1930 type-of-farming survey — *animal-specialty* and *dairy*. There were 497,000 of the first and 605,000 of the second. Farms were classified as animal-specialty if 40 per cent or more of their income was derived from the sale of beef cattle, sheep, hogs, or wool or mohair, and if they produced the major part of the feed consumed by this livestock. Very many of these, however, sell crops for cash in addition, and therefore come under the head of diversified-crop-and-livestock farms discussed in Chapters XIII and XIV. The same is true of a sizable fraction of the 605,000 dairy farms. Some of these dairy farms also buy so much of their feed that they more nearly fit the description of specialized livestock farms of Chapter IX. Poultry farms are dealt with in a special chapter in PART FIVE. They buy practically all their feed. Finally, the cattle and sheep ranches are also handled in separate chapters in PART FIVE. The 1940 census classified farms selling livestock or livestock products in about the same way as the 1930 census. It reported 726,000 livestock farms and 619,000 dairy farms. Farms of this description are heavily concentrated, it will appear, in the great feed and forage producing regions of the North Central states.

The order in which the different types of feed-and-livestock farms will be considered in these two chapters is as follows:

A. Dairy farms — on which the feed is mainly fed to dairy cows.
B. Corn-hog-cattle farms.
C. Corn-hog-dairy farms.
D. Feed-lot farms — in which feeder cattle, hogs, or lambs are bought and fattened, or feed is bought in quantity to fatten cattle or hogs raised for this purpose.

ORGANIZING PRINCIPLES

Obviously all of these farms have the problem of the feed ration, which was analyzed carefully in Chapter IX in terms of dairy cows. It includes both the rate of feeding and the make-up of the ration. Although the general principles are the same in the case of meat animals, the applications call for special consideration.

Such farms also present the problem of the combination of crops discussed in Chapter X, but the crops are feed and forage crops. Moreover, pastures must be considered as well as the harvested crops.

The unique organization problem of the farms qualifying as feed-and-livestock farms is that of the balancing of the feed and the livestock enterprises, and the adjustment of the one to the other. The Los Angeles dairy farm analyzed in Chapter IX could be any size desired so far as the feed was concerned. The farms discussed in this chapter are limited in size to the feed that is produced, unless the operator wishes to buy extra feed other than some protein concentrates to balance the ration. Or looking at the problem from the other side, the feed will not be properly utilized unless the farmer has the number and type of livestock that will use his feed to best advantage. The objective on such farms is, therefore, to fit the feed and the livestock together both as to quantity and as to type. It may, of course, pay to buy the extra feed and keep more livestock, or to keep fewer and sell some grain; but the fundamental economy of such a farm is in its feed-livestock balance.

The crop and livestock enterprises on farms of this type are in strong complementary relationship to each other — the feed crops furnish the raw materials out of which the meat and livestock products are manufactured, and the livestock contributes barnyard manure to the crops, which helps maintain their yields. But the supplementary relationships are no less important. The combination of crops and livestock keeps the labor employed much more nearly throughout the year, and the succession of pasture and hay and cultivated crops keeps the land

in fuller use over the season. Also, such farms provide full use for all of the crop by-products, such as the straw, corn stalks, and the rowen. In addition, on farms feeding whole corn to cattle, the hogs salvage the corn which is left in the droppings.

Such systems of agriculture are much more nearly self-sustaining over the years than the crop systems discussed in preceding chapters. Much less of the plant nutrients are sold off the farm. Given at the start the rich inventory of plant nutrients and humus already in the Prairie soils of the Midwest, such a system of farming, except on the sloping fields, can be continued for a very long time without serious depletion of the soil. Perhaps it can be continued indefinitely. The reserves of minerals in the subsoil are being drawn upon continually by the roots of some of the plants. If a little erosion occurs, the loss is replaced by the fragments of subsoil which the plow brings up and mixes with the topsoil. With such a system of farming, an occasional liming and application of a little phosphate, and potash on some of the farms, and a systematic plowing under of a crop of clover or other legume, seem to be all of the supplement which the more level of these lands need; and the sloping lands should in any case be kept in grass and close-grown crops as much of the time as possible.[1]

Even on the formerly timbered lands north of the Corn Belt, which had a relatively low inventory of available plant nutrients at the time they were brought into cultivation, the dairy farming practiced on them keeps them in good fertility. Dairy farming returns more plant nutrients to the soil in the form of manure than does other livestock farming, especially than hog farming. But even so, approximately half the nutrients fed the animals from the crops grown on the farm are either sold off the farm or lost in the handling of the manure. Much less of the land on dairy farms is in cultivated crops each year than on grain and hog farms, and this reduces the rate of soil losses. On the farms where lime, legumes, and fertilizers have been applied over a period of years, the productivity of the soils under present management may be higher than its original or inherent productivity. This fact is forced on the attention of the senior author every time he returns to his home community in southern Wisconsin. Erosion has been severe upon some of the sloping land that has not been farmed properly, but many of the other fields are yielding better crops today than thirty years ago.

Such farms are more intensive than those which grow grain or hay

[1] Evidence is accumulating that small amounts of boron need to be applied on many Midwest farms for good stands of alfalfa, and that there may be need for sulphur, magnesium, cobalt, and other so-called "trace" elements.

and sell it for cash because they put the grain and hay through a second production process that adds from 30 to 75 per cent to its value. Before 1900, most of the farms in western Minnesota and Iowa, and beyond into the Dakotas and Nebraska, were cash-grain farms. By 1930, a large fraction of them were feeding much or all of their grain to beef cattle, hogs, or dairy cattle. As a result, the value of product per acre increased markedly. The additional product was created by the investment of more capital per acre, in the form of livestock, buildings, and feed inventories, and by the application of more labor and management. For this and related reasons, the volume of agricultural production about doubled in Minnesota between 1900 and 1930.

The increase in farm labor force accompanying the transition from grain to livestock farming is particularly to be noted. The census figures show a marked increase from 1900 to 1930 in the number of farm laborers employed per farm in this area. Not only were more laborers employed, but they were more fully employed. They had winter work as well as summer work. The increase in the labor force was greatest in the counties that shifted to dairying.

The feed-and-livestock farms of the Midwest have made rapid technological changes since 1930. Many of them now have general-purpose tractors and have reduced their horse numbers to one team per farm. This has released additional feed for livestock at the same time that the timeliness and effectiveness of field operations have been improved by the use of the tractor. Hybrid seed corn, improved strains of oats, and increased use of alfalfa and other legumes have further increased the amount and quality of feed available for productive livestock. Farmers have also shifted to the purchase of baby chicks and artificial brooding and in this way have increased the quality and uniformity of their laying flocks. Many farms have also increased the size of their poultry flocks.

The size of the dairy herd has been increased on many farms to utilize the increased roughage available, and there has been a general increase in the amount of grain fed per cow. Milk production per cow has increased over a fifth on these farms in the last fifteen years. Hog numbers have been increased both on the farms where dairy herds utilize the roughage and on those where beef cattle are fattened. The increased production of soybeans has made available locally more high-protein meals for balancing the livestock rations. The increase in protein feeds in high-quality roughages has fitted in with a shift toward the fattening of younger beef animals to meet market demands for smaller cuts of beef. Had it not been for the increased protein supplies, it would

have been impossible to fatten the younger animals, which require more protein than older cattle, and at the same time maintain other livestock numbers.

A. *DAIRY FARMS*

Dairy farms are widely distributed over the country. Wherever there is a city population requiring fresh milk, there are dairy farms near-by to produce it. This is true even for the cities of Florida, and as we have noted, for southern California. Around each urban center there is a zone of dairy farms, in size roughly proportional to the size of the city. Anywhere from Cleveland eastward, most of the dairy production is devoted to supplying milk and cream for city markets. Also in this part of the country, much, and in some cases all, of the grain fed to the dairy herds is purchased. From Cleveland westward, however, most of the market milk producers grow a large part of the grain which they feed. This is true around Columbus, Indianapolis, Detroit, St. Louis, and Kansas City, as well as around Chicago, Milwaukee, and Minneapolis-St. Paul. On the Pacific Coast also, a belt of counties close to the ocean toward the north, and in the interior valleys in California, produces milk for the cities. This chapter is going to confine itself mainly to the dairy farms which produce nearly all their feed. The dairy farms in the East and around cities will be discussed in a special chapter on "Dairy Farming" in Part Five.

The center of the dairy farming which is based largely on home-produced feed is in the three Great Lakes states, Minnesota, Wisconsin, and Michigan. Chart 44 shows the type-of-farming areas of the 1930 survey for this territory. The darker-shaded areas are those in which 40 per cent or more of the income from the farms is from the dairy herds. The lighter-shaded areas have obtained more of their income from dairying than from any other source, but less than 40 per cent of it. The remaining areas around the fringes mostly have dairying as their second most important source of income. These are border-zone areas where income from hogs and/or beef cattle is more important than from dairying; or in a few sections, such as in the Red River Valley and northeastern Illinois, income from cash grain comes first. The enterprises in second place to dairying in the intermediate areas are potatoes in northern and central Wisconsin, and potatoes, other livestock, and fruit in the southern peninsula of Michigan. To the west and south, cash grain or beef cattle and hog production are the secondary enterprises.

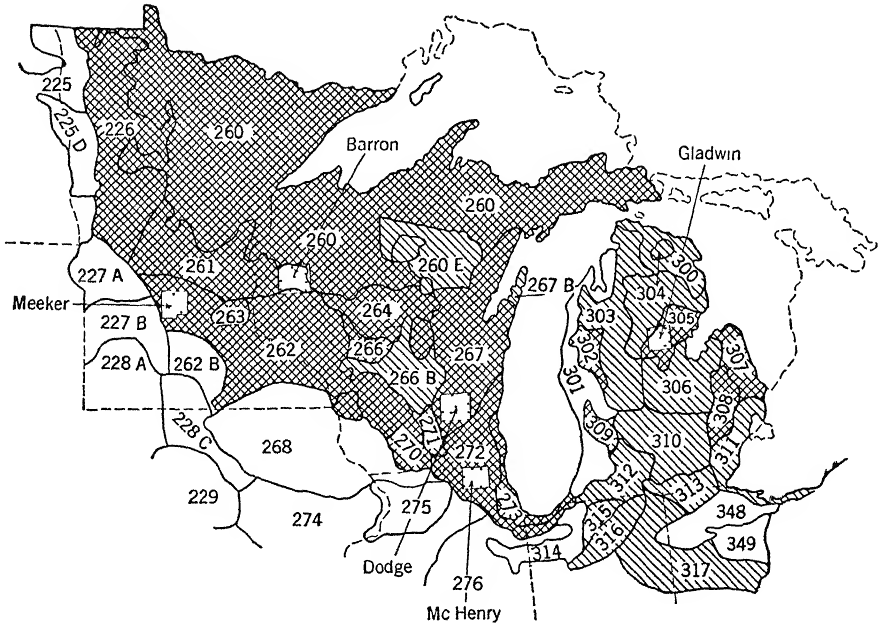

CHART 44. The dairy farming region of the Great Lakes states, and the five counties in Table 22.

Dark-shaded

226 N.W. Minn. — dairy, livestock, cash grain
260 The Cutover region — dairy, self-sufficing, part-time, potatoes, forest products
261 The Dairy-Potato area
262 S.W. Minn.–W. Wis. — dairy, general, livestock
263 Twin Cities milkshed
264 Central Wis.—dairy (cheese), potatoes
266 Central Wis. sand plains — dairy, potatoes, livestock
267 Eastern Wis. — intensive dairy
269 Vernon Co. — dairy, tobacco
270 Foreign Cheese area — dairy, some livestock
271 Dane Co. — dairy, tobacco
272–3 Chicago milkshed — dairy, truck
302 W. Mich. sandy area — general, dairy, self-sufficing
305 N.E. Mich. sandy area — general, livestock, dairy, self-sufficing, part-time
307 Thumb area — dairy, livestock, sugar beets
308 Oakland-Lapeer Co. — dairy, potatoes, fruit

Light-shaded

260e N.E. Wis. — dairy, potatoes, self-sufficing
266b Central Wis. sand plains — dairy, livestock, potatoes, canning peas
300 N.E. Mich. — general, dairy, self-sufficing
303 Central Mich. — dairy, potatoes, general
304 N. Central Mich. sandy area — general, dairy, livestock, self-sufficing, part-time
306 Saginaw Valley — dairy, sugar beets, beans, livestock
310 S. Cent. Mich. — general, dairy, livestock, beans
311 Detroit — dairy, truck, etc.
312–13 S. Mich. — general, dairy, livestock
315–16–17 N. Ind. — general, dairy, livestock, cash grain

This dairy region grows grass and forage much better than the Corn Belt, and corn not so well. The corn is of earlier maturing varieties which yield less, so that if this region had to depend on corn and hogs, it would be definitely at a disadvantage compared with the Corn Belt. But building an economy on grass and forage with corn only as a supplement, much of it used in the form of ensilage, this region can produce almost as much value of product per crop acre as the Corn Belt. Less of the land in this region, however, is in crops. Most of it was heavily glaciated and consequently has rather uneven terrain, with many lakes, marshes, sand plains, and stony patches. It was mostly covered with timber when the settlers came. Much of the land can therefore most profitably remain in permanent pasture, if not in woodland, and much of the rest of it should be plowed only often enough to reestablish good grass mixtures. The only way to utilize the production of such land is by means of cattle or sheep, and other circumstances favor dairy cattle over other livestock. Enough small grain for dairy cows can be produced on most of the farms, and at least enough corn for silage.

Farms in the northern part of this dairy area in 1935–1939 produced around three to four times as many total digestible nutrients in the form of hay and silage as in the form of grain. In the southern part of the area, the T D N's in the form of grain often equaled or exceeded those in hay and silage. In the strongly rolling areas of eastern Iowa and Minnesota and western Wisconsin, the T D N's produced in hay and silage usually exceed those produced in the grain.

Mention should also be made at this point of the dairy production of the northwest Pacific states of Washington, Oregon, and Idaho. Here are small areas outside of the city milksheds whose milk goes into butter or cheese which largely supplies the Pacific Coast needs for these products. Tillamook County, Oregon, well known for its cheese, can be taken as one type of dairy farming in the region. The dairy farms of the county grow relatively little grain, but the pasture season is so long that the feed purchases of the dairy farms in 1929 were only a fifth of the value of the dairy products. In Idaho, the dairying is mostly in the irrigated valleys, and based on a combination of alfalfa hay, sugar-beet pulp, and some grain.

The dairy farms in the Midwest have intensified their production in the past fifteen years. Wisconsin had a fifth more dairy cows in 1943 than in 1930. The group of farmers reporting regularly to the Wisconsin Crop and Livestock Reporting Service increased their feeding of concentrates from 960 pounds per cow in 1935–1936 to 1,240 in 1939–1940, and to 1,590 in 1942–1943. The additional feed has come from a reduc-

tion in horse numbers, the use of more lime and fertilizer, more legumes, and higher yields of both corn and oats. Oats furnish more of the concentrates than corn in the more northern counties. Soybeans are planted only as a temporary hay crop in most of this territory — the season is too short for a seed crop. In the more southern sections, however, they mature enough to serve as a source of protein concentrate.

Equally important have been the shifts in the utilization of the milk. Before the war, the milk was mostly used to make butter and cheese except in the city milksheds. The milksheds were expanding, however; and a few plants were converting the skim milk into powder which was shipped out to provide livestock feed for other regions. The war created a large demand for skim milk powder, and the more intensive dairy areas began delivering whole milk instead of cream. This has reduced the supply of skim milk for pigs and poultry. If this change in demand persists, these areas will specialize still more in dairying.

SELECTED COUNTIES The five counties in Table 22 are selected to show a wide range of conditions under which dairy-feed farming is practiced. All of them derive three fourths or more of their income from their dairy herds. Barron County is an outstanding dairy county in the northern part of the territory. It is too far north to grow much corn for grain, but in most years can grow fairly good corn for silage. Two thirds of the milk of this county went into butter before the war; but a few hogs are kept. The skim milk was made into powder during the war. Potatoes are grown on the lighter soils in the county, but not so extensively as in the counties to the north and east, which are still largely unsettled and likely to remain so. Dodge County grows more corn and raises more hogs on a combination of corn, skim milk, and whey from cheese factories. In 1939, only 4 per cent of the milk produced went into butter. The farms are relatively small in both of these counties. Per acre, the Barron County land is less productive than the Dodge County land, partly because it has a shorter growing season and partly for other reasons. Both counties buy some feed to supplement their home-grown rations. Gladwin County has poorer land and cows than Barron County.

McHenry County, farther south, grows considerably more corn, but its dairy farms are completely given over to producing milk for the Chicago market, and derives three fourths of its income from its dairy herds. It buys feed, but its feed bills of $390 per farm are a small fraction of the $4,110 of its value of product. Hence, this county produces about all the feed it uses in producing its market milk.

Meeker County is considered one of the leading dairy counties of Minnesota and it clearly belongs in the class of feed-and-livestock

farms, since 77 per cent of its income in 1929 was derived from livestock, about a fourth of this coming from hogs. Very little of Minnesota is as completely given over to dairying as is much of Wisconsin.

The number of dairy cows increased markedly in all these five counties from 1930 to 1940 — by as much as a fourth in two of them — and increased further during the war. The number of hogs increased fully as much in four of them. The additional feed required came from larger yields, but also from larger acreages of corn and hay. The trend in most dairy-farming areas has always been toward intensification.

TABLE 22. ORGANIZATION OF DAIRY FARMS IN SELECTED GREAT LAKE STATES COUNTIES, 1929

	S.E. Minnesota	*Minn.-Wis. Dairy Potato Area*	*Eastern Wisconsin*	*Chicago Milk-shed*	*N.E. Mich. Dairy Area*
Type number of area	262a	261c	267a	272	305
Combination	Dairy General	Dairy Potatoes	Dairy Hogs	Dairy Hogs	Dairy
Percentage of land in area in:					
Crops	61	43	62	60	40
Pasture	31	46	29	32	52
Hay	17	18	18	17	21
Corn	16	11	22	27	5
Small grain	22	11	14	12	7
Percentage of farms:					
Dairy	50	79	87	72	40
General	29	7	5	5	37
Crop-specialty or cash-grain	9	4	1	3	4
County	Meeker Minnesota	Barron Wisconsin	Dodge Wisconsin	McHenry Illinois	Gladwin Michigan
Number of farms in county	2,479	4,480	4,586	2,607	1,107
Dairy farms:					
Number	1,247	3,566	3,988	1,877	447
Value	$13,188	$8,100	$14,900	$18,000	$3,541
Acres	148	109	117	146	117
Crop acres	99	47	72	91	22
Value of products — total	$2,610	$2,220	$3,200	$4,110	$1,480
Number of:					
Milk cows	12	11	13	18	7
All other cattle	10	10	10	11	9
Sows and gilts	5	0.5	2.0	1.4	1.0
Feed expenditure	$80	$155	$240	$390	$95
Percentage of income from:					
Livestock products	49	63	62	74	48
Livestock	28	12	19	17	24
Crops	9	11	8	3	7

RATE OF FEEDING

The relations between inputs of T D N and protein are, of course, no different on dairy farms in the Midwest than on those in the Los Angeles milkshed considered in Chapter IX. But the problem of determining the most profitable rate of feeding takes a different form because the dairy feeds are mostly not purchased. To be sure, one can assign a value to the home-produced feeds equal to what they could be sold for in local markets and arrive at determinations exactly paralleling those presented in Table 14 and Chart 34 in Chapter IX. *But the determinations so made will be theoretical ones in any area which is not regularly in the business of producing feed crops for sale*, that is, which is not on a feed-surplus basis. If the area grows its feeds wholly or very largely to be fed to dairy cows, they derive their value from their contribution to the product of the dairy herds. A few individual farmers in a dairy-farming area could, of course, shift to selling a good part of their feed for cash without upsetting feed prices in the local markets; but no large fraction of them. Moreover, few farmers are likely to do this because they would no longer get full use of their dairy farms and their labor and would suffer reduced incomes. These statements apply particularly to such forms of feed as pasture grass, corn silage, corn stalks, and straw; and equally to such products of the dairy herds as skim milk and manure.

The problem in hand has a much simpler and more realistic solution. All that the farmer really has to do, if he has a definite fixed quantity of feed available, is to decide how many cows to divide it among — to answer the question, for example, "Will I make more money if I feed this feed to sixteen or to some larger or smaller number of cows?" Usually, of course, he also has some latitude as to how much feed he will produce, and can vary the number of cows by varying the acreages and yields of his crops. The problem is best analyzed by assuming, first, that the feed supply is fixed. The largest output of milk from a given amount of feed is obtained when each cow is fed at the point of highest output per unit of feed input. This is at Point L in Chart 35 — around 6,300 T D N pounds. At this point, we learned in Chapter IX, the cow's body is exactly maintained and all additional feed goes into milk production.[2] If the same labor, management, buildings and equipment were used whether more or fewer than sixteen cows were kept, Point L would be the final answer to the question. This would mean that if a farmer had 100,000 T D N pounds of feed for his milking herd, exactly sixteen head of milk cows would be needed.

[2] See p. 197. This statement is for a cow weighing 1,130 pounds.

Given these sixteen cows, the next question is, "Will it pay me to grow more than 100,000 T D N's of feed for them?" The most direct way of obtaining an answer is to balance the additional cash costs involved in producing the additional feed against the additional milk produced. The additional cash costs will depend upon how the additional feed is produced, whether by substituting corn silage for oats or barley, or alfalfa for clover-timothy, or increasing the yield per acre of corn or small grain, or fertilizing or otherwise improving the pastures. Obviously what is called for is full budget analysis. Such an analysis is presented following in terms of a fifteen-cow dairy farm of 115 acres, with 59 acres in crops, in Barron County, Wisconsin. The work on this farm is done entirely by the proprietor and his two boys who go to school nine months of the year.

A FAMILY DAIRY FARM, *Barron County, Wisconsin*

ORGANIZATION, 1943

Crops	acres	*Livestock*	number
Corn (grain)	9	Milk cows	15
(silage)	8	Bull	1
Oats	18	Culls on hand (ave.)	1.2
Mixed hay	20	Young cattle	8
Alfalfa	4	Sows	1
Rotation pasture	12	Chickens	86
Other pasture, partly wooded	41	Horses	2
Farmstead and other	3		
	115		

Equipment: One tractor, grain binder, mower, hay loader, silage cutter, cream separator, plow, harrow, wagon, etc.

OPERATING STATEMENT, 1943

Receipts		*Expenses*	
Milk — 802 cwt. at $2.80	$2,245	Feed — protein supplements — 9,100 lbs.	$228
Eggs — 758 doz. at 36¢	273	Baby chicks — 200	28
Cull cows — 3 at $75	225	Veterinary	24
Veal calves — 9 at $15	135	Milk hauling — 802 cwt.	96
Hogs — 12 cwt. at $14	168	Silo filling	20
Chickens — 400 lbs. at 22¢	88	Threshing	22
	$3,134	Seed	48
		Repairs, gas, and oil	142
		Taxes and insurance	142
		Miscellaneous	48
			$798

Inventory change — Depreciation of buildings, equipment, and workstock	$160
Net Business Gain	$2,176

In addition, one cow, two hogs (400 pounds), and twenty-eight chickens were home slaughtered. The family also used 45 hundredweight of milk and 160 dozen of eggs.

Before any changes in the feeding program on this farm can be considered, the present production and utilization of the feed must be analyzed. With no change in the closing inventory from 1942 to 1943, the disposition of the feed was as indicated following:

FEED PRODUCTION AND DISPOSITION

	Corn (bu.)	*Oats (bu.)*	*Mixed hay (tons)*	*Alfalfa (tons)*	*Silage (tons)*	*Protein supplement (purchased) (lbs.)*
Production	270	720	34	8	64	9,100
Disposition						
Milk cows	110	445	19	8	51	4,500
Young cattle	—	95	9	—	9	100
Bull	5	20	2	—	1	200
Culls on hand	13	35	2	—	2	—
Hogs	120	32	—	—	—	300
Chickens	22	43	—	—	—	4,000
Horses	—	50	2	—	1	—
Total	270	720	34	8	64	9,100

The feeds in the table equal 3,960 T D N pounds per cow, to which must be added pasture feed equivalent to 75 full days, making a total of 4,990 T D N's. The cows were on grass for 160 days, but during all but five weeks of this time some concentrate and corn silage was fed as a supplement. The maintenance requirement for cows averaging 1,010 pounds per cow, the average for this herd, is 2,920 T D N's. This left 2,070 T D N's for milk, which according to the Morrison standard, and also according to Chart 35 in Chapter IX, should produce 6,100 pounds of milk testing 4.2 per cent milk, the average for this herd. The average production per cow was 5,880 pounds, counting in the small amounts fed to calves (3,500 pounds) and used by the family (4,500 pounds). The difference is easily explained by feed wastes. The nutritive ratio was 1 : 8.5.

With production at this low level, the alternative which suggests itself first is that of feeding the same feed to fewer cows. If the 59,400 T D N's consumed by milk cows on the farm in 1943 had been fed to varying

Consider the first of these changes: The present rotation system has 12 acres in two-year-old meadow each year, and 6 acres in new meadow, and 18 acres each in corn and oats. (Some irregularities are introduced from year to year because the fields are not equal in size, and because of the starting of a new three-year alfalfa seeding every three years.) The new rotation would have 18 acres each in new hay seeding, corn, and oats. The yield of the hay is increased 0.20 tons per acre, the T D N's, 25 pounds per ton, and the crude protein, 35 pounds per ton. The nutritive ratio is narrowed to 1 : 7.8. The increase in T D N's per cow would be about 350, and in protein, about 90 pounds. In addition, the corn yields would be increased a little and the milk sales somewhat. The production per cow should be increased 750 pounds. The herd receipts would be increased $300. The extra cash expense will be seeding 6 extra acres and hauling 11,000 pounds extra milk, a total of $20. There will be several days' extra labor at haying time.

The second alternative would involve substituting corn silage for first-year hay as well as corn for oats, since less oats would be available for a nurse crop. A 6-acre shift would work out best in a rotation system. Since 6 acres of corn would be grown two years on the same field, the average corn yield would be reduced $1\frac{1}{2}$ bushels per acre, and the silage in the same proportion. If half of this corn were grain and half silage, the T D N's would be increased 175 pounds per cow, and the protein left about the same. Milk sales would increase 350 pounds per cow, or $150 for the herd. The extra labor in caring for 3 acres of corn for grain and 3 acres of corn for silage would be 12 days. The cash outlays would remain virtually unchanged.[3]

This shift assumes that the farmer has silage capacity for 3 more acres and the cows would consume the additional silage. If not, and the 6 acres of corn were harvested for grain, the increase in milk sales would be only $75.

The third alternative raises the whole question of the use of alfalfa. Where alfalfa is adapted to the land, it has a great advantage over the usual mixture of clover and timothy both because of higher yields per acre of total digestible nutrients and because of the higher protein content of the hay. A dairy ration based on home-grown feeds is low in protein and always needs to be balanced by the purchase of additional high-protein meal. Hence, the more protein the hay contains, the less protein meal that must be bought. Dairy farmers in the Midwest have adopted alfalfa slowly. Also, they have been inclined to leave an alfalfa

[3] It would be wise if this shift were made to apply enough fertilizer to the 6 acres of corn to maintain yields at their present level or even increase them.

field in hay or pasture as long as a fairly good stand remains. This practice of setting a field aside from the regular cropping sequence when it is seeded to alfalfa often causes other land on the farm to be overcropped. Many farmers have seeded red clover and timothy instead of alfalfa because they have not wanted to keep their fields seeded down for more than one or two years. In recent years, however, farmers are tending to introduce alfalfa in their regular cropping sequences, expecting to plow it up at the end of the second year. If the alfalfa is adapted to the soil, and the soil is in a high state of productivity, it will yield enough more feed per acre than clover and timothy in two years to more than repay the cost of the extra soil treatment and higher-priced seed.

If 6 acres on this Barron County farm were shifted from mixed hay to alfalfa each year, this would increase the T D N's by 270 pounds per cow, the crude protein 100 pounds, and the milk sales $225 for the herd, assuming no change in yields. The labor load would be increased six man-days, and haying would conflict with the corn cultivating much more than at present.

The simplest way of increasing the feed supply would be to apply 125 pounds per acre of 3–12–12 fertilizer to the 17 acres of corn each year. This would increase the corn yields five bushels per acre. An outlay of $40 for fertilizer would increase the milk sales by $125 and add very little to the labor load. Soil specialists recommend the use of 0–20–20 or 0–9–27 fertilizer at 300 to 400 pounds an acre on the small grain and new seedings as well as on corn. They also recommend an initial application of around four tons of lime on acid soil and another ton each succeeding 10 years. This treatment would increase the yield of hay over a half ton per acre, and corn and oats yields in the rotation by 20 per cent at least. An annual outlay of $140 on fertilizer used in this way would increase milk income over $400 a year.

Applying three tons of lime per acre every 10 years to 12 acres of rotation pasture and 12 acres of other open pasture, and also 200 pounds of fertilizer per acre at a total cost per year of $22, would presently increase the yield of the pastures the equivalent of $90 in milk sales.

Brushing 15 acres of the best of the permanent pasture, liming it and applying 250 pounds of 0–20–10 fertilizer per acre, and reseeding it with a mixture of clover and grasses would involve an initial cash outlay of $180, plus an average of $15 per year for subsequent liming and fertilization. These costs reduced to an annual basis would amount to $23. It is estimated that five man-days and six horse-days of labor per acre would be required for the brushing, disking, and seeding of the pasture, plus some contour-ridging on the stronger slopes to secure

better absorption of the rainfall. This work could be done over two or three years in the late fall between the corn harvest and the first heavy snowfall, and at other odd times during the year. The additional pasture feed thus obtained could easily increase milk sales by $150. One could assign some arbitrary value to the man and horse labor of improving the pasture, reduce these to an annual basis, add the $23 of annual cash costs and come out with a "profit" of so much per year. Or, instead, one could subtract the annual cash costs plus some allowance for horse labor reduced to an annual basis, from the extra receipts, and come out with an annual net return of perhaps $100 for the 75 days of man labor invested in this undertaking. Or one could be content merely with balancing the $150 of increased annual income against the original investment of 75 days of man labor and 90 days of horse labor. One would be in as good a position to decide whether the undertaking would be worth while in the latter case as if one had made the estimates required for the two preceding determinations, and would be *less likely to be led astray by faulty imputations of value to man labor and horse labor.*

Obviously, various combinations of alternatives 1 to 5 might pay better than any one of them by itself — for example, 2 and 3, or 2 and 4. Or if the farmer is prepared to enlarge his dairy enterprise and increase his barn room, he can add these changes one after another, and raise his production eventually to a high level.

When the demand and price for milk rise suddenly, as at the onset of a war, the tendency of dairymen is to expand production by purchasing feed supplements. They did this in 1942–1943. Next in order, they are likely to apply commercial fertilizer to their feed crops and pastures. Given more time, most farmers will find it more economical to reorganize their farms to produce more and better feed and forage, build more silage capacity, and improve their pastures and meadows by clearing, draining, and contour-ridging, and by stocking them with better species of grass and clover. Progress in this direction is likely to be retarded by the lack of good cows. It may have to wait until such time as they can be bred and reared — productivity in cows is by no means freely reproducible.

COMPOSITION OF THE RATION

The problem of composition of the ration on farms producing their own feed differs from that on farms buying all their feed in that the ration needs to be adjusted to the feeds that are produced to best advantage on the farm, and the feed production program, in turn, to the feeds

used to best advantage by dairy cows. Some farms, for example, do not have fields well suited to alfalfa or to red clover, but grow an alsike-and-timothy mixture well. In the northern fringe of the Corn Belt, the best source of the silage needed as a succulent feed is surely corn; in northern Minnesota, it may be oats and peas. Or the area may be one with an abundance of roughage, but which grows corn and small grain only at high cost. The price of milk may not warrant paying freight on large inshipments of grain. The area may, therefore, be one producing less milk per cow, but producing it largely from roughage. Or for similar reasons, an area may find itself producing with an unusually wide nutritive ratio.

The guiding principle in balancing the rations, not only in such situations as these, which are cited only as examples, but in all cases in which the feed is mostly produced on the same farm, is that what to feed the herd and what types of feed to grow cannot be independent determinations, but both must be established at the same time. This means that alternatives in what feed to produce must be judged by their effect on the output and sales of milk and accompanying effects on cash outlays.

This farm in Barron County is so far north that none of the six alter natives, or any combination of them, will produce a ration with a high enough ratio of concentrates to roughage. Many conflicting statements have been made in recent years as to this ratio. During the late thirties, when interest in improving the soil was growing rapidly, instances of profitable dairy enterprises based largely or solely on pasture and roughage feeding were publicized. But such farms are likely to be limited to areas where the pasture and winter roughage are of very high quality — alfalfa hay and perhaps grass silage — and where the cows freshen in the spring. Unless grain is very high priced relative to both roughage and milk, it is profitable to feed grain in addition to roughage. The most economical balance of the two depends partly upon the relative prices of milk and grain. It is ascertained by the same marginal analysis as was used to discover the most profitable level of feeding on the Los Angeles dairy farm. The usual ratio of hay and silage to concentrates on dairy farms in the Midwest before the war was about three to one.

OTHER MANAGEMENT PROBLEMS

By no means does the foregoing exhaust all the possibilities of choices on Midwest dairy farms. In the more southern counties, many farms obtain good yields of soybeans. Why not grow these for a protein supplement and save feed bills? This presents a typical problem in budget

analysis. First, one must estimate the effect on the farm receipts of shifting land from corn or oats to soybeans. Against these effects must be balanced the savings in cost of protein supplements. Then some allowance must be made for erosion losses if the soybeans are substituted for oats. The soybeans may also be so high priced that it will pay to sell them and buy other protein supplements.

The decision to raise all the heifer calves and have dairy cows and heifers for sale, or to raise only the heifers from the highest-producing cows in the herd for replacement purposes, often turns on the housing and labor available for care of the milking herd. It is also affected by the amount of pasture available and the price of milk. In those areas where pasture is plentiful, milk prices are lowest relative to the national average, and where skim milk is available on the farms, farmers usually find it profitable to raise extra females for sale as milkers or breeding stock. Dairy farmers who have a relatively high-priced milk market find it more profitable to utilize their feed in keeping extra producing cows — supplementing their home-raised replacements from time to time by the purchase of an extra cow or two if their herds drop below the number that can be fed, housed, and milked.

Cow-testing associations' records have established the fact that under usual farming conditions the cows which freshen in the fall produce around 10 per cent more milk than those which freshen in the spring or summer. Fall freshening also provides employment for the farm labor force during an otherwise relatively slack winter season. But in spite of these advantages, large numbers of dairy farms still follow the practice of having their cows freshen in late winter, spring, and summer. The reasons for this will be considered in Chapter XLII.

The decision to sell whole milk or cream involves the value of the skim milk as a livestock feed on the farm and the market price of whole milk. Farms which keep hogs and chickens value highly the skim milk as a protein supplement of their grain, and the premium offered for whole milk may not be enough to warrant selling on this basis. As already pointed out, if they do sell whole milk, they are likely to keep fewer hogs and chickens.

Other possible changes on the Barron County farm are as follows:

1. Feeding grass silage in part instead of dry hay or corn silage.
2. Not keeping a bull, depending upon artificial insemination instead.
3. Raising no hogs except for home slaughter, feeding the skim milk to heifer calves and selling a cow now and then.
4. Selling cull cows promptly, not fattening any for home slaughter, etc.
5. Increasing the size of the poultry enterprise.

PASTURE MANAGEMENT

The problem of managing pastures so as to make them contribute most to the farm income confronts all livestock farmers, even hog farmers; but it is particularly a problem for dairy farmers and is therefore introduced at this point. Succeeding chapters will revert to the subject frequently.

The aspects of pasture management that are most important to dairy farming are as follows:

1. Many dairy farms do not have enough good pasture to carry as many cows through the pasture season as they can feed through the winter. As a result, milk production falls off in the summer unless supplemented by barn or yard feeding of corn silage or other succulent feeds, alfalfa or clover hay, and some concentrates. This supplementary feeding is still inadequate on a majority of the dairy farms of this country. Cows freshening in the spring and falling off in milk production in the late summer are not likely to recover much of it when winter barn feeding is started.
2. A phase of the foregoing is the unevenness of the pasture feed supply over the pasture season, especially if no measures are adopted to make it more even. The grass is so abundant in May and June that the cows may not graze closely enough, and so scanty during the high temperatures of July and August that the cattle may go hungry and lose flesh as well as fall off in milk production.

The method which dairymen tend to adopt to meet these conditions is to reduce the pasture acreage to what the cows can handle in May and June and put the acres thus released into corn silage, alfalfa, and other grain and forage crops, to provide the supplementary feeds needed later on. This is a labor-consuming method of handling the problem, and it may be a relatively expensive one too. Alternatives that are being urged frequently at present are the following:

A. Do not reduce the pasture acreage, and perhaps even increase it, and at the proper stage cut the grass and clover that have not been eaten and make hay of them, or grass silage, to provide the supplementary feed needed later on. Pastures grow rapidly after such mowing.

B. Fence off part of the pasture in the spring and cut a crop of hay before turning it into pasture.

C. Full rotation or controlled grazing — that is, pasturing the cows in succession on strips of the pasture that can be closed off easily by electric fencing. This method has the advantage that the cattle

can be turned into any strip at the stage when the grass is most nutritious and taken out before they graze the pasture too closely, which is not shorter than two or three inches. Mowing some of the strips is also likely to be necessary.

D. Growing supplementary annual forage crops to keep up the feed supply in the late summer and early fall. Dairy farmers have long fed green corn for this purpose, but commonly they have not fed enough of it. Corn silage, with mature corn in it, is better feed and represents a fuller and better use of the land. Sudan grass, millet, rye for the early spring in the North, and winter oats in the South, and several other species, are now used in this way in different regions.

E. Improving the mixture of pasture plants. Common white clover combined with blue grass not only provides forage that comes along after the blue grass, but it shades the ground and reduces the soil temperatures in the upper two or three inches by as much as ten degrees on hot summer days, with the result that the grasses thrive better also. Ladino clover produces more feed than common white clover, and has a somewhat later season. Some dairymen are also now using mixtures of alfalfa and smooth brome grass or orchard grass, or reed canary grass on damper soils. The grazing of alfalfa needs to be controlled, but when it is thus controlled, and alfalfa is combined with these other grasses, it provides more nearly continuous feed than any other species. The best mixture to use, of course, depends upon temperature, rainfall, soils, and other factors. In various parts of the South, Bermuda grass, Dallis grass, Johnson grass, lespedeza clover, carpet grass, and black medic are used in pasture mixtures. The Europeans have developed this phase of pasture management much farther than we have.

F. Liming and fertilizing the pasture. This not only increases the plant growth, but makes it persist better through the summer. Lime, phosphate, and potash are needed by the legumes, and nitrogen by the grasses. In a mixture of grass and legumes, the legumes provide the nitrogen needed by the grasses.

G. Restocking or renovating old pastures by plowing and reseeding with a nurse crop, and liming and fertilizing at the same time; or by disking and reseeding with fertilization; or by using a furrow seeder that plows a small furrow at intervals of a few feet and seeds at the same time. Furrow seeders are especially suited to plants that, after first seeding, spread from seed, like lespedeza, or by means of stolons, like Ladino clover.

H. Mowing the weeds in pastures just before they go to seed; likewise removing low brush like sweet fern and juniper.

I. Contour-ridging of pastures on slopes to collect the water and prevent erosion.

The farm management problem is to determine which one of these, or combination of them, will add most to the net farm income, by producing the most feed of the kinds needed and fitting best into the other operations on the farm. To make a choice among the different methods or combinations requires making estimates as to their effects on the feed supply and the milk output, on the productivity level of the land, and on the cash outlays for feed, fertilizer, seed, labor, and equipment. The amount of labor which they involve is not very important within ordinary limits, except under the following circumstances: (1) when the labor must be hired for it; (2) when the labor must be done at a time that conflicts seriously with other farm operations; (3) when the farm family already has all the work which it can do. Very little experimental or other data have been collected that will be of much use to farmers in such determinations. Accordingly, all that they can do is exercise their best judgment and feel their way along from year to year.

The most difficult estimate to make is that of the amount of feed obtained from pasture. The method used earlier in this chapter is the best available. It consists of calculating the amount of maintenance plus production required to produce the amount of milk produced while the cattle are on pasture, and subtracting the calculated T D N pounds in the supplementary feeds from the total and converting the remainder back to T D N's. One weakness of this method is that cattle frequently lose or gain weight in the late summer. Also any feed wasted is credited to livestock and this reduces the imputed value of pasturage. But waste can be approximated by comparing milk production with feed inputs in the winter months and calculating a percentage of waste that can be applied in the summer also.[4]

Attempts to estimate the value of pasture in dollars per month are likely to be of little use in choosing among pasture management practices. *They commonly reflect only the prevailing judgment of dairy farmers as to the value of pasture land when it is not well managed.* The farmers who have developed efficient methods of pasture management impute much higher values to pasture land.[5]

[4] The estimates will also include the effects of errors in estimating the T D N values of the feeds.

[5] See Chapter XXXIII.

FURTHER READING

H. R. Cox and Gilbert H. Ahlgren, *Improved Pastures from Better Grasses and Legumes*, New Jersey Circular 492, 1945.

T. R. Nodland and G. A. Pond, *Managing the Dairy Herd for Greater Returns*, Minnesota Bull. 378, 1944.

EXERCISES

1. Are there any farms in your home county that fit the general description of a feed-livestock farm in this chapter? If so, set up an organization for a typical one, showing crop acreages and production, feed consumption by livestock in relation to feed production, and receipts and expenditures.
2. Test out several promising alternative organizations, using the best available information.
3. On the basis of current prices, what is the cost of 100 T D N pounds in corn, oats, alfalfa hay, and mixed hay? On the basis of customary pasture rentals and carrying capacity, what is the cost of 100 pounds T D N in the form of permanent pasture? How do you explain the differences in costs thus computed?
4. Describe a pasture and feeding program adapted to your home county, that will care for 15 dairy cows throughout the year. At what seasons will there be most difficulty in supplying adequate feed at reasonable cost? How can this situation be improved?
5. If you had a farm with a relatively large acreage well-adapted to pastures and only a small acreage well-adapted to crops, what kinds of livestock and feeding programs could you adopt?

CHAPTER XII

Feed-and-Livestock Farms

— continued

WE NOW PASS TO THE FEED-AND-LIVESTOCK FARMS OF THE GREAT Corn Belt. Although these farms can operate without cattle, all of the corn being fed to hogs, nearly all of them have some cattle because only in this way can the grass on some of the non-arable lands be utilized, the by-product roughages, and the hay commonly included in the rotations. Similarly, a Corn Belt livestock farm can operate without hogs, but in that case the corn in the droppings is wasted. Consequently, virtually all such farms combine hogs and beef cattle. The difference is only in the proportions of these.

B. *CORN-HOG-CATTLE FARMS*

Farms making this corn-hog-cattle combination, as stated before, were called animal-specialty farms in the 1929 type-of-farming survey. Such farms are concentrated as they are in the Corn Belt because they depend upon corn as a cheap source of concentrated digestible nutrients. No other crop grown in this region yields as many T D N's per acre as corn, except alfalfa, and even a steer is not able to eat enough alfalfa to make it really fat. Soybeans compete most closely with corn in this region in quantity of concentrated feed per acre. They are likely to be continued for this reason, although probably not at wartime levels. They have not replaced corn to any important extent. They have crowded out the small grains instead. Corn produces a fat animal, either a hog that yields a high percentage of lard, or beef in a high state of finish, differing importantly from the beef fattened on grass in this country. This type of beef is expensive to produce as compared with that produced on grass because of the labor and capital that goes into the production of corn. However, enough families in the United States

have incomes large enough to afford this expensive type of beef so that it ordinarily has a good market.

The distribution of corn-hog-cattle farms can be judged from Chart 42 in Chapter X. The territory included in Areas 183 and 230, in South Dakota, Nebraska, and Iowa, west and south of the cash-grain areas, has little else but corn-hog-cattle farms. Areas 231, 274, 280, and 318, also adjoining the cash-grain areas, mostly have more corn-hog-cattle farms than any other kind; and the same is true of some of the sections eastward into Ohio, especially of the Fayette-Champaign Area in central Ohio. The principal center of such farming is almost the whole state of Iowa. The other center is central Indiana and the western half of Ohio. The gap in eastern Illinois is the cash-grain area discussed in Chapter X. Another small gap is the cash-grain area in central Iowa.

Other grains are grown along with corn to make up the rotation systems of this territory, but corn furnishes the key to all of them. Corn is grown in this region because climate, rainfall, and soil are better suited to corn here than in any other large area in the world. Throughout this region, the land is relatively level, with deep, fertile, warm, black soils rich in lime, nitrogen, and organic material. But the climate is fully as important as the soil. The average summer day temperatures of 70–80°, and the average night temperatures of 55°, make ideal conditions for the growing of corn. The growing season runs from 130 to 140 days in the Corn Belt proper. The heaviest rainfall of this territory comes in the summer months when the corn crop needs it most.

To the north, the frost-free season is shorter and the summers are cooler, therefore grass, small grains, and dairying increasingly replace corn, hogs, and beef cattle. Toward the east are the rougher lands of eastern and southern Ohio, and to the south, the rough mountain areas of eastern Kentucky and the Ozarks of Missouri, or the level lands between suited to cotton and tobacco. The western boundary of the Corn Belt is established by rainfall — small grain requires less rain than corn.

SELECTED COUNTIES The farming practiced on the corn-hog-cattle farms in this region may be examined more carefully in the five selected counties in Table 23. These stretch from Cedar County in northeastern Nebraska across to Fayette County in southwestern Ohio. Around 60 per cent of the farms in each of these counties were classified as animal-specialty in the census. From two thirds to three fourths of the land was in crops. Corn is the major crop in all of them, but at the western edge in Cedar County, Nebraska, some wheat is sold as a cash crop.

TABLE 23. ORGANIZATION OF CORN-HOG-CATTLE FARMS IN SELECTED COUNTIES, 1929

	Iowa-S. Dak.-Neb. Hog-Cattle Area	*S. Iowa Livestock Area*	*W. Ill.-E. Iowa Livestock Area*	*E. Ind. Livestock Area*	*Central Ohio Livestock Area*
Type number of area	183a	230	274	323	353
Combination	Hogs Cattle	Hogs Cattle	Hogs Cattle	Hogs	Hogs
Percentage of land in area in:					
Crops	77	57	67	68	62
Pasture	19	38	27	27	33
Hay	8	11	10	7	8
Corn	36	28	34	33	28
Small grain	29	14	20	23	20
Percentage of farms:					
Animal-specialty	62	50	60	60	59
General	11	19	16	18	15
Dairy	1	5	3	1	2
Cash-grain or crop-specialty	22	8	12	12	11
County	Cedar Nebraska	Warren Iowa	Mercer Illinois	Rush Indiana	Fayette Ohio
Number of farms in county	2,193	2,521	1,841	1,875	1,569
Animal-specialty farms:					
Number	1,349	1,250	1,103	1,134	923
Value	$22,300	$17,500	$22,600	$15,500	$14,500
Total acres	222	174	195	154	185
Acres in crops	157	93	113	100	102
Value of product	$4,070	$3,475	$4,290	$4,096	$3,638
Feed purchased	$480	$340	$560	$470	$260
Number of:					
Beef cows	5	4	5	2	3
Milk cows	4	4	3	1	1
Other cattle	19	14	15	4	8
Sows and gilts	16	8	13	6	10
Percentage of income from:					
Livestock	72	72	75	68	68
Livestock products	9	12	11	10	11
Crops	9	7	7	15	14

The eastern counties also sell some corn and wheat for cash. Warren County, Iowa, is in an area where the lands are somewhat rougher than in central Iowa and more of the farms are classified as general. The lower section of the table presents data for the animal-specialty farms only. Three fourths of the income of the farms in the three western counties was from livestock, and only a little less in the eastern counties.

The census reports very few cattle on these farms. Many of the beef cattle are purchased as feeders and kept only part of the year. In general, however, these farms are hog farms much more than they are beef cattle farms. This is particularly true of those in Rush and Fayette Counties.

ORGANIZATION, 1943

Crops	*Acres*	*Livestock*	*Number*
Corn	80	Beef cows	10
Oats	30	Milk cows	4
Alfalfa	37	Calves	9
Soybeans	10	Yearlings	9
Total crops	157	Feeders fattened	32
Rotation pasture	37	Bulls	1
Nontillable pasture	20	Sows	32
Farmstead and waste	6	Boars	2
Total	220	Pigs fattened	194
		Chickens	75
		Horses	2

Equipment: Tractor and accessories, truck, automobile, corn picker, hay loader, manure spreader

OPERATING STATEMENT, 1942–1943 [a] (*October to September*)

Receipts			
Butcher hogs — 145, or 315 cwt. at $14 00	$4,410		
Sows — 29, or 102 cwt. at $13.25	1,352		
Boars — 2, or 7 cwt, at $12 00	84		
Feeders — 32, or 320 cwt. at $15.80	5,056		
Yearlings — 9, or 102 cwt. at $15.00	1,530		
Cows — 2, or 26 cwt. at $12.00	312		
Milk — 240 cwt. at $2.90	696		
Eggs — 600 doz. at $.40	240		
Soybeans — 210 bu. at $1.80	378		
Miscellaneous	65		
Total		$14,123	
Expenses			
Feeder cattle — 32, ave. weight 700 lbs. at $84.00	$2,688		
Protein feed — 9 tons at $70.00	630		
Fertilizer — 4 tons at $38.00	152		
Alfalfa seed — 150 lbs. at $ 50	75		
Seed corn — 12 bu. at $7.00	84		
Custom combining — 30 at $2.50	75		
Hired labor — 8 mos. at $110	880		
Hog vaccination — 180 hogs at $.50	90		
Repairs and servicing	215		
Fuel and oil	160		
Taxes and insurance	310		
Miscellaneous	65		
Total		$5,424	
Net Business Gain			$8,699

FEED PRODUCTION AND DISPOSITION

	Corn (bu.)	*Oats (bu.)*	*Alfalfa (tons)*	*Protein supplement (purchased) (tons)*
Production	5,200	1,200	88	9.0
Disposition				
Beef cows [b]	—	—	8.0	—
Milk cows	40	200	8.0	0.5
Calves [c]	—	35	1.0	—
Yearlings [d]	—	—	7.0	—
Bull	—	—	.8	—
Feeders fattened [e]	1,200	—	43.0	1.1
Yearlings fattened [f]	380	—	13.7	0.3
Sows	550	200	0 5	1.0
Boars	30	10	—	0.1
Pigs fattened	2,920	600	2.0	5.0
Horses	—	80	4.0	—
Chickens	75	75	—	1.0
Total	5,195	1,200	88	9.0

[a] Feeding year, October to September; 30 of the pigs raised are kept over for sows the following year.
[b] Rest of ration was corn stover and oats straw
[c] Fed after weaning until 6 months old.
[d] From 6 to 18 months old, growing ration, half alfalfa and half corn stover, and pasture in summer.
[e] Bought at 700 lbs. and sold at 1,000 lbs. (ave.)
[f] From 850 pounds to 1,130. These yearlings gain 20 pounds less than the 700-pound feeders in the same feeding period and use 7 per cent more feed. Normally they sell at a small discount per hundredweight.

The major trend in land use in these counties from 1930 to 1940 was toward less land in crops, especially corn, and more in pasture. Soybeans increased more than tenfold in Warren and Fayette Counties, and fourfold or more in Mercer and Rush Counties. In Rush and Fayette Counties, the soybeans replaced oats mostly; in Warren and Mercer, corn mostly. Cattle numbers increased in all the counties, dairy cows more than beef cows. Hog numbers declined markedly in the western counties, and increased in the eastern. The wartime changes tended toward more corn and soybeans and more livestock of all types.

Such farms have all the management problems of combining feed and livestock production just considered, but in addition those of combining two kinds of livestock. Rates of feeding and related problems, moreover, need to be considered for both hogs and beef cattle.

A CORN BELT INDIANA CORN-HOG-CATTLE FARM The farm chosen to exemplify these problems is a 220-acre farm located in the livestock area of south central Indiana. It has been chosen because it has a sizable cattle as well as a hog enterprise. It is near enough to a city to sell milk, and therefore keeps a few more milk cows than needed for the family. Some of the beef cows also may be milked in part for a month or two. This farm, like many corn belt farms, follows the system of obtaining one litter of pigs from young sows in the spring and then fattening them. Part of the corn is hogged off and part of it is picked with a picker. The feeder cattle are purchased just after corn harvest and sold in the spring. The margin of selling over purchase price in 1942–1943 was $1.80 per hundredweight. The hogs obtain a little of their feed from the droppings. The calves run with the cows in pasture the first summer, forage on corn stover in the field in the fall and early winter, are fed corn stover and alfalfa until put on pasture the following spring, and go on fattening rations along with the feeders in the fall. They weigh 850 pounds on the average at that time, compared with the 700 pounds for the feeders. They gain 280 pounds while the feeders are gaining 300 pounds. This farmer has help enough from his family only for the four winter months.

THE HOG ENTERPRISE

The hog and cattle enterprises on such farms each have management problems that are special for them. These need to be analyzed separately before the problems involving combination of enterprises can be considered intelligently. Most of these problems can be considered either on the basis of the individual animal as the unit, or of the herd as a unit, as we have already noted in dairy farming. In the first case, animals of given weights are considered by themselves; in the second, account is taken of the feed and other inputs involved in maintaining the sows and raising the pigs to weaning age. The first steps in the analysis will be on the individual-animal basis.

RATE OF FEEDING, INDIVIDUAL-ANIMAL BASIS The problem of the rate of feeding a hog seems very simple — the more feed that the hog can be made to eat, the more economical would appear to be its gains, since its maintenance ration of 5 T D N's daily per 1,000 pounds is then divided among more and more pounds of gain in weight. Nevertheless, a majority of the hogs fed in this country are fed under this optimum. We need to consider why this is true. Table 24 shows how the

gain in weight per 100 pounds of total feed intake declines when additional feed is fed to 200-pound hogs. The 26 T D N pounds input producing a gain of 33 pounds per 100 accords with the Morrison feeding standards and the results of twelve Corn Belt feeding trials summarized by Atkinson and Klein.[1] How much more than this 26 pounds per day a 200-pound hog can be induced to eat is uncertain, but the more it is, the cheaper the gains, assuming no difference in the prices of the feed used. There is no problem here of part of the feed going into another product as in the case of a dairy cow or a hen. Gains in weight are proportional to feed input over maintenance at any given level of weight and of age of the animal. As we shall see later, the figures in the last column would be larger if the hogs were younger and lighter, but they would be in about the same proportions.

TABLE 24. VARIATIONS IN GAINS IN WEIGHT WITH VARYING FEED INPUTS, PER 1,000 POUNDS OF LIVE WEIGHT, HOGS WEIGHING 200 POUNDS

Total ration—T D N's	*Maintenance ration—T D N's*	*Growth and fattening ration—T D N's*	*Daily gain in weight per 1,000 live weight*	*Gain in weight per 100 T D N's*
20	5	15	6.0	30.7
22	5	17	6.8	31.7
24	5	19	7.7	32.5
26	5	21	8.5	33.2
28	5	23	9.3	33.8
30	5	25	10.1	34.3
32	5	27	11.0	34.7

A principal reason that many hogs are fed under the optimum is that the farmers do not know how to obtain the optimum. In particular, they do not know how to feed their hogs rations which include essential proteins, minerals, and Vitamin D (the antirachitic vitamin), and the hogs as a result do not have good appetites. The grains do not contain some of the essential proteins or amino acids. These must be obtained from such feeds as skim milk, buttermilk, tankage, alfalfa, clover or rape. The calcium needed for rapid growth is supplied best by skim milk and by legume pasturage or hay. Some of the minerals, frequently

[1] L. J. Atkinson and John W. Klein, *Feed Consumption and the Marketing Weight of Hogs* U.S.D.A., Tech. Bull. 894. 1945. The Committee on Animal Nutrition of the National Research Council recommends 28 T D N pounds for a 200-pound hog. See its report, *Recommended Nutrient Allowances for Swine*. Washington, D. C., 1944 (25 cents).

calcium, must be supplied directly, in the form of bone meal or ground limestone.[2]

Other farmers also fail to obtain economical gains because they go too far in assuming that hogs make cheaper gains if forced to consume a large amount of pasture feed. Hogs are also often underfed because the farmers do not have grain enough. A farmer who has 50 hogs ready to fatten will often do well to sell 10 of them as feeders and feed his corn and supplements to only 40. According to Table 24, the quantity of feed required to feed 39 hogs at the Morrison standard will produce 10 per cent less total gain in weight if it is fed to 50 hogs instead. Or a better alternative in many cases will be to full-feed the hogs while the feed lasts and sell them as lightweight hogs.

Full feeding does not pay best, however, at all stages in the growth of hogs in all circumstances. For example, if April-farrowed pigs are full-fed from weaning time on, they are too far along for hogging off corn in the fall, or to follow steers in feed lots. The farmer may therefore want to practice *deferred feeding*, that is, feed a growing rather than a fattening ration for three months or longer in the summer and early fall, even though this means a somewhat higher ratio of maintenance to growth ration.

Also, there are many scattering situations in which a cheap supply of some feed that does not make a full hog ration warrants feeding a more or less unbalanced ration — paralleling the case of dairy cows fed largely on cheap roughage as a way of using this roughage. Garbage feeding of hogs is an extreme example of this.

The final decision between full feeding or something less than this is bound up with other decisions such as the time of farrowing of the sows, one or two litters a year, and what feed crops are grown, and often cannot be made except in terms of a full budget analysis.

THE MARKETING WEIGHT OF HOGS A related and equally important problem is the weight at which hogs are marketed. The daily rate of gain of pigs and hogs on full feed, measured in pounds of live weight, increases from birth until the hog weighs 200 pounds, and then declines. According to the summary made by Atkinson and Klein of the twelve feeding trials conducted in the Corn Belt, presented in Chart 45, at the peak the hogs gain 1.71 pounds per day at 200–210 pounds, and only 1.32 at 300 pounds.[3] The main reason for this is that an animal's

[2] The minerals and vitamins required for proper bodily functioning and rapid gains in weight are outlined carefully by the Committee on Animal Nutrition of the National Research Council in its report, *Recommended Nutrient Allowances for Swine*.

[3] The National Research Council figure is 1.8 pounds per day at 200–250 pounds. This is apparently a little higher than obtained under actual farming conditions.

body gains weight faster while it is growing rapidly than when it is mainly adding fat — muscle and bone are cheaper to produce than fat. In keeping with this, the larger animals eat less in proportion to their weight. A 125-pound pig eats its weight in feed every 28 days; a 275-pound hog, every 37 days. Table 25 gives the data of Chart 45 arranged according to the weight of the animal rather than by days from birth, because they answer some questions best in this form.

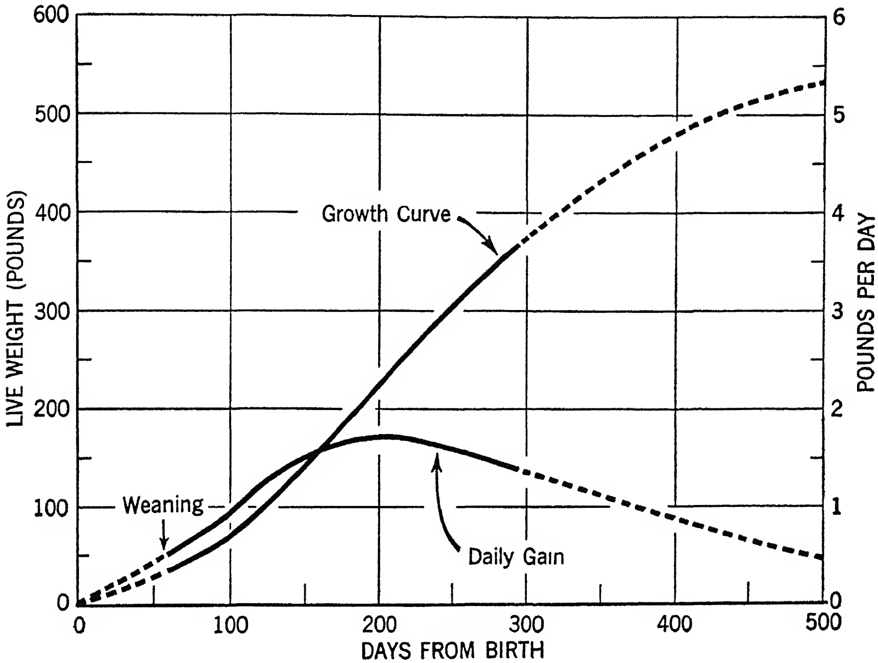

CHART 45. Growth curve, and daily gain in weight for hogs, based on twelve Corn Belt feeding trials. The solid lines are based on actual data; the broken lines are statistical projections. (Reproduced from Atkinson-Klein data by permission of the B A E.)

The most useful form of the data is that of Column 7 of Table 25 — the gain in live weight per 100 additional pounds of feed. A farmer can forecast the amount he is likely to receive for his hogs if he feeds his 200-pound hogs the additional sixteen days required to make them weigh 225 pounds, compare it with the amount he will receive if he sells now, and balance the increase against the value to him of the 100 pounds of feed.

This is not as easy, however, as may at first seem. First, the market price of the hogs may change during the sixteen days. Second, the value

of the 100 pounds of feed is uncertain. Third, some account must be taken of the fact that the rations of heavier hogs need contain slightly less protein and are a little cheaper.

TABLE 25. INPUT-OUTPUT RELATIONS AT DIFFERENT LIVE WEIGHTS OF HOGS

(Col. 1) Live weight (pounds)	(Col. 2) Age (days)	(Col. 3) Feed per day (pounds)	(Col. 4) Gain in weight per day (pounds)	(Col. 5) Total feed (pounds)	(Col. 6) Feed used to produce 100 pounds live weight (pounds)	(Col. 7) Additional live weight per 100 pounds additional feed (pounds)
35	60					
50	82	2.3	.68	51	101	29.3
75	109	3.2	.93	137	183	28.2
100	129	4.6	1.28	228	228	27.2
125	146	5.6	1.49	322	257	26.1
150	161	6.5	1.66	420	280	25 0
175	175	7.0	1.72	522	298	23.9
200	190	7.2	1.68	628	314	22.9
225	206	7.1	1.59	741	329	21.8
250	223	6.9	1.48	858	343	20.7
275	241	6.8	1.37	982	357	19.6
300	260	6.5	1.25	1,113	371	18.6

Source: Derived from data in Atkinson-Klein report, especially Tables 10 and 12.

As for the first of these, Chart 46 shows the average seasonal variation in prices of 250-pound hogs in 1934–1941. The decline from September to December is pronounced. The prices of 200-pound hogs averaged 7 cents more than for 250-pound hogs, but in three fall months, they sold at a slight discount. The 300-pound hogs sold for 22 cents less than the 250-pound hogs. Clearly the season of the year when the farmer is considering adding another 25 pounds of weight to his hogs is a matter of much concern. The average of past seasons shown in the chart can serve only as a general guide.

As for the value of the additional 100 pounds of feed, one can impute a value to corn and alfalfa hay at what one can get for them delivered to market, less cost of delivery, but this is really valid only in areas and on farms in which these are commonly being produced for the market. In much of the livestock area of the Corn Belt, many of the farmers do produce more or less corn, oats, soybeans, or wheat for a cash market,

and hence values imputed in this way are more likely to be in accord with the facts than in the dairy-farming areas considered in the preceding chapter. Not many Corn Belt farmers, however, produce alfalfa for sale, and the skim milk used as a protein supplement has little or no off-the-farm value in some areas.

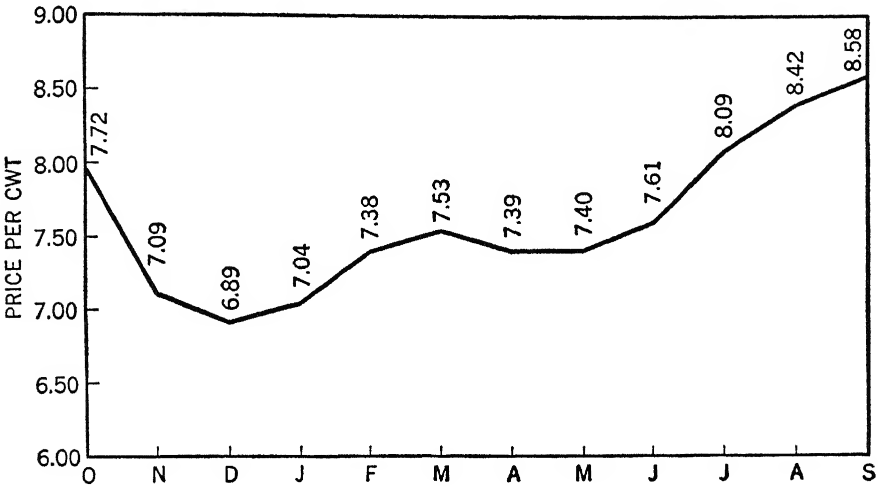

CHART 46. Average monthly prices, 250-pound good and choice hogs, Chicago market, 1934–1941. (Based on Table 13, Atkinson and Klein.) The prices were adjusted for cyclical and trend movements before they were averaged.

WHEN TO HAVE SOWS FARROW At what weight to market hogs is closely related to the time of farrowing. Chart 47 shows that pigs farrowed in December reach 200 pounds, if full-fed, at a time when prices are high and still rising, whereas those farrowed in March reach 200 pounds just when the market is weakening rapidly in the fall. Those farrowed in April strike a market already weak and declining further, and those farrowed in September a sustained market at a somewhat better level. In some situations, the September pigs may to advantage be pointed for the July market by keeping them on a growing ration only for a few months. Other things being the same, it would seem best to full-feed the March-farrowed pigs and sell them at 200 pounds or less in September–October. This means fattening them on old corn.

The early farrowed pigs also need warmer buildings and more attention unless death losses are to be high. The general use of electricity at farrowing time to keep the pigs warm, and improvements in housing and equipment are reducing these losses. More storage space is also required to carry over the corn, and the income from much of the corn

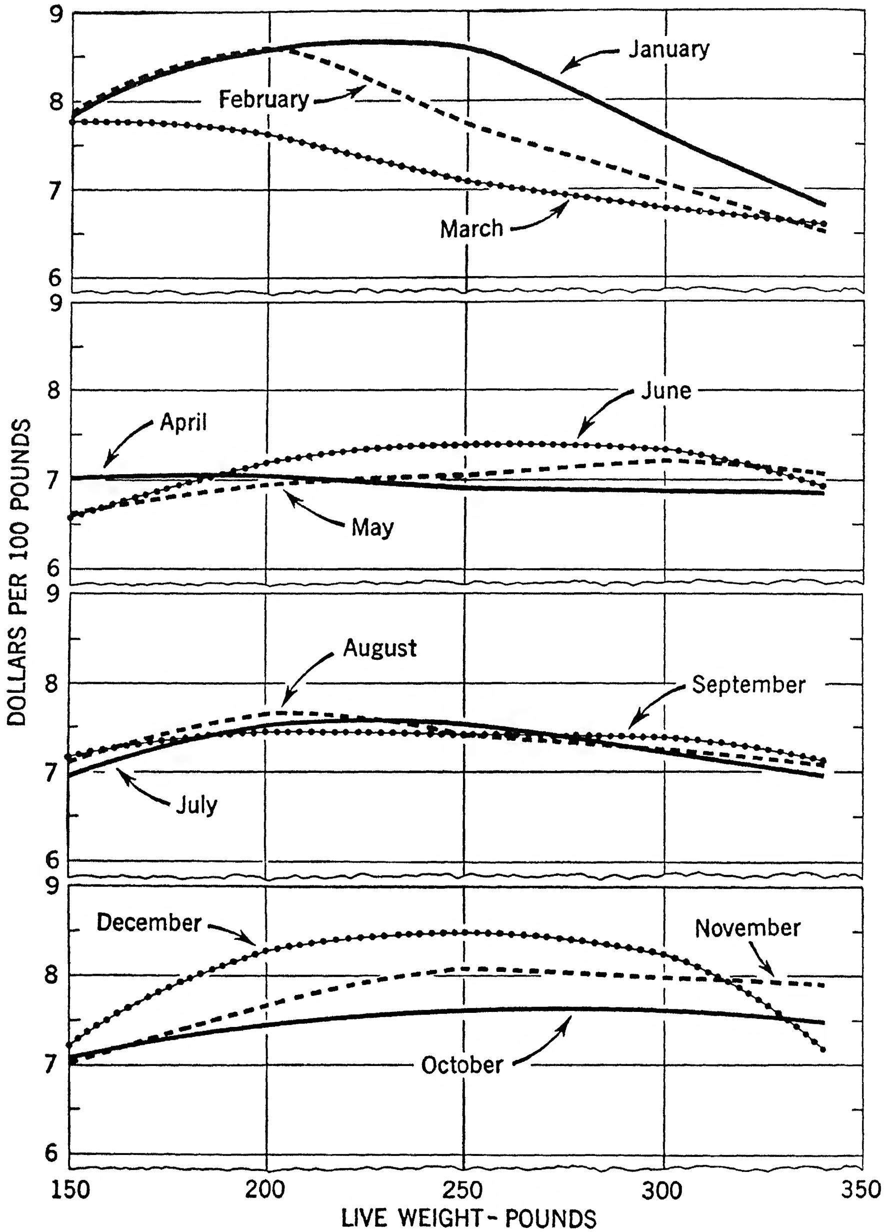

CHART 47. Prices received in 1934–1941 for hogs farrowed in different months and full-fed till they reach varying weights. (Reproduced from Figure 5 in Atkinson and Klein by permission of the B A E.) Each month shown is the month of farrowing, and the prices for each weight are those that would be received in the month when the hog reached that weight. if usual practices were followed. Thus, the effective prices for the pigs farrowed in April are the October price for 150 pounds, November price for 200 pounds, December price for 250 pounds, etc.

crop is not received until September and October of the year following the harvest of the crops. It must be borne in mind also that the price advantage of early-marketed hogs will decline as more farmers adopt this program. Under the usual system, the pigs are fed on a growing ration of corn and ground oats while they run on pasture through the summer. As soon as the corn crop matures, they are full-fed on the new corn until ready for market sometime in November to January. It is commonly believed that the lower costs of this system offset the lower prices and longer maintenance period. Often they do not. The particular circumstances in any area, and to some extent on particular farms, will determine what combination of farrowing and feeding programs will pay best. Budgeting the receipts and expenses of alternative combinations will reveal the one offering the largest net advantage.

FEEDING AND FARROWING PROGRAMS ON A HERD BASIS Analysis such as the foregoing gives the final answers only in situations in which a farmer already has a certain number of hogs, or amount of feed, and needs to know how to make the most out of these from then on. Whenever a farmer makes plans for his hog enterprise a year or so in advance, he must figure also on the cost of maintaining his breeding herd and raising the pigs to weaning age. Atkinson and Klein have estimated, on the basis of survey data from Corn Belt farms, that 270 pounds of feed are needed per pig on farms following the one-litter system, and 200 pounds on farms following the two-litter system, as feed for the sows and boars of the breeding herd up to the time when they are sold. During this period, however, they gain 24.0 pounds in weight per pig on one-litter farms, and 20 pounds on two-litter farms. When these amounts of feed are added as fixed overhead to those in Table 25, and the 24 and 20 pounds respectively to the live weights, Columns 5 and 6 of Table 25 are changed to Columns 4 and 5, and 7 and 8, of Table 26. Feed input per 100 pounds of gain starts rising much later as hogs are fed to heavier weights if the feed for the breeding herd is counted in too, because the greater the weight of the hogs, the less the overhead per pound. These differences are large enough to change the decision as to whether to feed another month at some seasons of the year, or perhaps to have the sows farrow in October rather than in September. A further slight factor of advantage in feeding to heavier weights is that the rations cost less per pound as the hogs become fatter because they include less protein. The extra protein of growth rations may, however, be cheaply provided in the form of legume pasture or hay or rape.

HERD DIFFERENCES The foregoing data are based mainly on experiment station feeding trials. They show larger outputs per pound of feed than obtained on a majority of farms. The individual farmer can rely upon such data only to give him general guidance. If he will keep the simple feeding records outlined in Chapter XXIII, however, he can adapt such data to fit his particular conditions. He can determine whether his hogs are averaging the 329 pounds of feed per 100 pounds live weight for 225-pound hogs shown in Table 25. Corn Belt farmers have made much progress in feeding hogs more efficiently in recent decades. R. D. Jennings has estimated that Corn Belt herds in 1938–1940 averaged only 428 pounds of concentrates per 100 pounds gain compared with 443 pounds in 1929–1933.[4] The better farmers are exceeding these averages by sizable margins. Another decade should show significant further gains.

TABLE 26. DATA OF TABLE 25 ADJUSTED TO INCLUDE MAINTENANCE OF BREEDING HERD

		One-litter systems			*Two-litter systems*		
Live weight (pounds)	*Age (days)*	*Live weight plus overhead (pounds)*	*Total feed, hogs and herd*	*Feed fed to produce 100 pounds live weight (pounds)*	*Live weight plus overhead (pounds)*	*Total feed, hogs and herd*	*Feed fed to produce 100 pounds live weight (pounds)*
(*Col. 1*)	(*Col. 2*)	(*Col. 3*)	(*Col. 4*)	(*Col. 5*)	(*Col. 6*)	(*Col. 7*)	(*Col 8*)
35	60	59	270	458	55	200	364
50	82	74	321	434	70	251	359
75	109	99	407	412	95	337	355
100	129	124	498	402	120	428	357
125	146	149	592	397	145	522	360
150	161	174	690	396	170	620	365
175	175	199	792	398	195	722	370
200	190	224	898	401	220	828	376
225	206	249	1,011	406	245	941	384
250	223	274	1,128	412	270	1,058	392
275	241	299	1,252	419	295	1,182	401
300	260	324	1,383	427	320	1,313	410

Source: Based on data in Atkinson-Klein report, especially Table 10.

[4] U.S.D.A. Circular 670, *Feed Consumption by Livestock, 1910–1941*.

THE BEEF-CATTLE ENTERPRISE

The principles involved in beef-cattle rearing and feeding are virtually the same as in the case of swine, but some major differences in the character of the animals affect considerably the application of these principles. The first of these is that beef cattle eat a much larger proportion of roughage than hogs. They will grow thriftily on nothing but good roughage, and fatten on nothing more than good corn silage, although at a somewhat reduced rate. This means that the maintenance ration can consist of cheap feeds, and even the growth ration, and that more time can be taken to mature the animal, especially if cheap forage is available. The second factor is the longer growth period of cattle. This in combination with the first factor makes it more feasible to rear the young animals in a region where roughage is abundant but not grain, and to fatten them in a region where the opposite is true. A third factor is that the roughage which cattle eat normally provides all the minerals and vitamins needed. Some supplementing of the proteins is needed, however, especially if the roughage does not include clover or alfalfa, particularly during the period of rapid growth.

Some Corn Belt livestock farms raise all the cattle which they fatten. If so, they are likely to full-feed them almost from the time they are weaned and sell them as baby beeves. Good Corn Belt land will produce so many more feed units in corn than in pasture and hay — especially southern Corn Belt land — that not enough forage is grown for the long-feeding of cattle. More commonly a Corn Belt farm, like the Indiana farm here used as an example, will buy half or more of its young stock from cattlemen on the Great Plains who cannot grow corn, and short-feed them, thus getting the fullest gain in weight per ton of its corn.

Formerly the feeders bought for fattening in the Corn Belt were mostly two-year-olds that had run two summers on the ranges in addition to their summer as calves. Now they are more often yearlings or calves. The older the animal, the more it needs to be fattened to make its beef tender. The public is coming to prefer beef which is tender because still young and has less waste fat than is found in the carcasses of highly finished older steers.

RATE OF FEEDING — INDIVIDUAL ANIMAL BASIS The maintenance requirement of a beef animal is presumably the same as for a dairy animal, 8.0 T D N's daily per 1,000 pounds weight of the animal. A 1,000-pound steer on full feed consumes around 17 T D N's daily per 1,000 pounds of weight according to the Morrison tables. This means

that only 53 per cent of its ration goes into gain in weight, compared with 79 per cent for a 200-pound hog on full feed, as shown in Table 24. If this steer is long-fed, moreover, with only a moderate allowance of concentrates, Table 27 shows only 46 per cent of the ration going into gain in weight at 800 pounds, and 39 per cent at 1,200 pounds.

TABLE 27. RATIONS AND GAINS OF LONG-FED STEERS ON A MODERATE ALLOWANCE OF CONCENTRATES, AT DIFFERENT AGES AND WEIGHTS, MORRISON STANDARDS

Weight	*Age (days)*	*Total daily ration (T D N pounds)*	*Daily maintenance ration (T D N pounds)*	*Daily growing ration (T D N pounds)*	*Percentage growth of total ration*	*Nutritive ratio 1:*
(*Col. 1*)	(*Col. 2*)	(*Col. 3*)	(*Col. 4*)	(*Col. 5*)	(*Col. 6*)	(*Col. 7*)
200	107	3.6	1.6	2.0	56	5.2
300	183	5.2	2.4	2.8	54	5.9
400	252	6.6	3.2	3.4	52	6.5
500	318	8.0	4.0	4.0	50	6.9
600	375	9.3	4.8	4.5	49	7.1
700	432	10.6	5.6	5.0	48	7.2
800	489	11.9	6.4	5.5	46	7.3
900	548	13.0	7.2	5.8	45	7.5
1,000	609	14.0	8.0	6.0	43	7.6
1,100	676	14.9	8.8	6.1	41	7.8
1,200	742	15.7	9.6	6.1	39	8.0

The Corn Belt beef producer of today, however, has little practical use for the data of Table 27. He produces beef by taking animals that have been grown at a more or less normal rate up to a certain age or weight and then forces their growth by full feeding until they are in good marketable condition. Data on feed inputs for normal growth rates, and on rates of feeding and resultant gains for "fattening calves," "fattening yearling cattle," and "fattening 2-year-old cattle," are given in a table of "Recommended Nutrient Allowances" published by the National Research Council in 1945. Also the results are now available for the recent three-year feeding trials conducted by the Iowa Experiment Station with the object of comparing feed inputs and gains in weight of cattle for these same three age classes. The two sets of data are not strictly comparable because the first are averages for heifers

and steers combined and the second are for "choice feeder steer calves," "choice feeder yearling steers," and "choice feeder 2-year-old steers." Steers make somewhat larger gains than heifers.

Table 28 is based so far as possible on the table of Recommended Allowances. This table, however, presents only average daily gains for the whole period for the last three groups — 2.0 pounds for calves, 2.2 pounds for yearlings, and 2.4 for two-year-olds. In Table 28 the averages are differentiated by weights according to data in Tables 9, 11, and 13 of Aaron G. Nelson's Technical Bulletin 900,[5] which is based upon the Iowa experiments. The shape and slopes of the curves for the two sets of data are identical.

Our interest is mainly in the slopes of the curves. Chart 48 presents the results in the form of growth curves paralleling those in Chart 45 for hogs. With *normal* rates of growth, these cattle, starting at 400 pounds, gain 600 pounds in 480 days, at an average rate of 1.25 pounds per day. The daily ration of 7.0 T D N pounds for the 400-pound calf is used 3.2 for maintenance and 3.8 for growth. The daily ration of 9.5 for a 1,000-pound animal is used 6.4 for maintenance and only 3.1 for growth.

The calves here considered go on full feed at 220 days and remain on full feed until they weigh 900 pounds at 450 days, thus averaging 2.0 pounds gain per day. They make their largest gains around 600 pounds. At 600 pounds, their daily ration of 9.5 T D N pounds is almost exactly half used for growth and fattening, and similarly for the 14.5 ration at 900 pounds. The yearling steers here considered go on feed at 360 days, weighing 600 pounds, and gain 500 pounds in 230 days, at an average rate of 2.2 pounds per day. Their ration of 13.5 T D N pounds at 700 pounds goes 58 per cent into gain in weight, and their 17.0 T D N ration at 1,000 pounds, as indicated earlier, 53 per cent into gain. The two-year-old steers go on feed at 700 days weighing 800 pounds and gain 400 pounds in 170 days, at an average rate of 2.4 pounds per day.

The data in which beef producers are mostly interested, however, are those in Column 6 of Table 28, which show the gains in weight per 100 pounds of the additional feed fed to obtain the last increment of gain. They can match the costs of a hundredweight of feed, or what they could get from it in another use, against the expected selling price of this much beef, to see at what point costs and selling prices equal each other, this being the point of highest-profit combination. Also given dependable data of the type presented in Column 6, they are able to

[5] *Relation of Feed Consumed to Food Products Produced by Fattening Cattle*, U.S.D.A., Tech. Bull. 900, 1945.

TABLE 28. INPUT-OUTPUT RELATIONS IN FEEDING CATTLE AT DIFFERENT AGE PERIODS

Weight	*Age — days*	*Feed per day — T D N's*	*Gain per day*	*Feed fed to produce total gain — T D N's*	*Feed fed to produce 100 pounds additional gain*	*Gain per 100 T D N pounds additional feed*
	(*Col. 1*) [a]	(*Col. 2*) [b]	(*Col. 3*) [b]	(*Col. 4*) [c]	(*Col. 5*) [a]	(*Col. 6*) [d]
			Normal Growth			
400	220	7 0	1.6	435	435	46.0
600	355	8.5	1.4	1,035	600	33.3
800	530	9 5	1 2	1,825	790	25.0
1,000	700	10.5	1.0	2,875	1,050	19.0
			Fattening Calves Finished as Short Yearlings			
400	220	8.0				
500	265	9.5	1 95 [e]	485	485	20.6
600	300	11.0	2.10 [e]	1,010	525	19.2
700	355	12.0	2.05 [e]	1,595	585	17.2
800	400	13.5	2 00 [e]	2,265	670	14.9
900	450	14.5	1.90 [e]	3,040	775	13.0
			Fattening Yearling Cattle			
600	360	11.5				
700	395	13.5	2.75 [e]	490	490	20.4
800	435	14.0	2.50 [e]	1,050	560	17.8
900	480	15.5	2.25 [e]	1,740	690	14.5
1,000	530	17.0	2.00 [e]	2,590	850	11.8
1,100	590	17.5	1.65 [e]	3,595	1,000	10.0
			Fattening Two-Year-Old Cattle			
800	700	15.0				
900	732	16.0	3.10 [e]	515	515	19.4
1,000	770	17.0	2.65 [e]	1,155	640	15 6
1,100	810	18.0	2.25 [e]	1,955	800	12.5
1,200	870	18.0	2.60 [e]	3,075	1,120	9 0

Source: Based on the *Recommended Nutrient Allowances for Beef Cattle* of the National Research Council, Table 1, and on Tables 9, 11, and 13 of the U.S.D.A. Tech. Bull. 900.
[a] Calculated from gain per day.
[b] From table of Recommended Nutrient Allowances.
[c] Calculated from Columns 2 and 3.
[d] Calculated from Column 5.
[e] The average daily gains in the table of Recommended Allowances distributed by weights according to Tables 9, 11, and 13 in Technical Bulletin 900.

judge whether fattening calves or yearlings, or yearlings or two-year-olds, will pay best. The data of Table 28 are not to be taken as fitting any particular area or herd or type of cattle. But they do show the relationships clearly. The gains per 100 pounds additional feed reported by Nelson for the Iowa steers average 3.0 pounds higher than those in

Table 28 for fattening calves, 0.8 pounds higher than those for fattening yearlings, and 1.1 pounds higher than those for the two-year-olds.[6]

RATE OF FEEDING — HERD BASIS As in the case of swine production, planning operations in advance calls for taking into account the maintenance of the breeding herd as well as the growth gains of the fattening animal. Table 29 compares the gains, expressed as averages per 100 pounds of gain in weight, on an individual-animal and a herd basis.

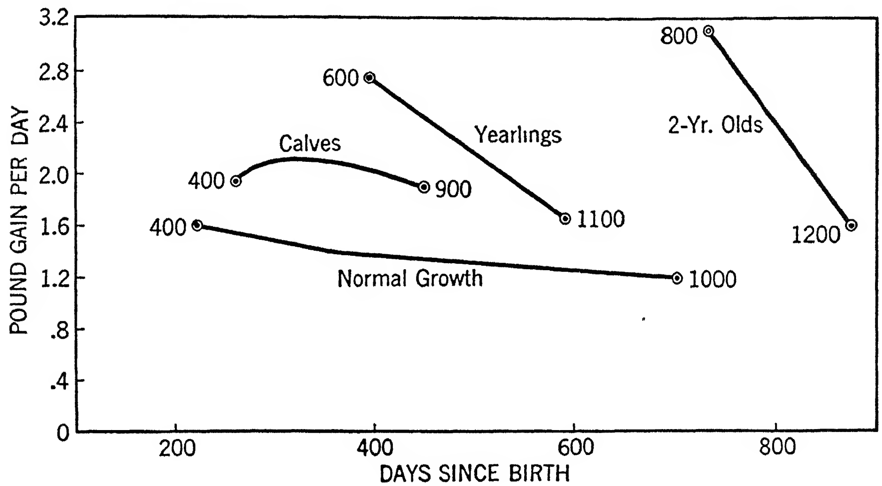

CHART 48. Growth curves for beef cattle at normal growth rates and as fattening calves, yearlings, and as 2-year-olds. (See Table 28 for data.)

The figures on the herd basis are highly approximate. They assume a beef-breeding herd held constant at 15 cows averaging 1,250 pounds, and one bull, and 5 calves raised from each cow before she is sold. The ration allowed for this breeding herd is the 10 T D N's per 1,000 pounds live weight as given in the Morrison tables. This means an overhead of 6,500 T D N pounds for each animal fattened. The gains in weight of the breeding herd are assumed to be 220 pounds per animal fattened. Selling as yearlings rather than as calves will mean more livestock on the farm and somewhat more feed to produce. Thus 12 calves sold at 800 pounds would require 120,000 T D N pounds; 12 yearlings at

[6] Nelson's bulletin concerns itself largely with the output of edible food per unit of feed input. Dressing percentages, and hence prices, are higher for the heavier animals. Calories of food per unit of feed input increase to around 700 pounds with fattening calves, and to 800 pounds with yearlings, and to 900 with two-year-olds. These increases, however, are all in fat rather than in proteins, and fats can be produced more cheaply in other ways. The fat contributes much, however, to the tenderness of the lean meat.

1,000 pounds would require 136,000 T D N pounds; and 12 two-year-olds at 1,100 pounds, which is probably as heavy as it would pay to feed them, would require 138,000 T D N pounds. A farmer might choose instead not to raise more feed, but to reduce his breeding herd to 13 cows.

TABLE 29. AVERAGE RATES OF GAIN ON AN INDIVIDUAL AND HERD BASIS COMPARED

Individual-animal basis			*Herd basis*			
WEIGHT	FEED SINCE BIRTH [a]	FEED PER 100 POUNDS WEIGHT	WEIGHT [b]	BREEDING HERD [c]	TOTAL FEED	FEED PER 100 POUNDS WEIGHT
			Fattening Calves			
500	1,715	345	720	6,500	8,215	1,140
600	2,240	375	820	6,500	8,740	1,060
700	2,825	405	920	6,500	9,325	1,010
800	3,500	440	1,020	6,500	10,000	980
900	4,270	475	1,120	6,500	10,770	960
			Fattening Yearlings			
700	2,755	395	920	6,500	9,255	1,000
800	3,315	415	1,020	6,500	9,815	960
900	4,000	445	1,120	6,500	10,500	940
1,000	4,855	485	1,220	6,500	11,355	930
1,100	5,855	555	1,320	6,500	12,355	950
			Fattening Two-Year-Olds			
900	3,570	400	1,120	6,500	10,070	900
1,000	4,210	420	1,220	6,500	10,710	880
1,100	5,010	440	1,320	6,500	11,510	870
1,200	6,130	510	1,420	6,500	12,630	890

[a] Assuming normal growth until the animal goes on full feed and fattening ration thereafter, as in Table 28.
[b] Weight of animal plus gain in weight of breeding herd per animal fattened.
[c] Feed fed to breeding herd per animal fattened. (See text for explanation.)

Any one of a number of factors might change the general level of the results from those in the last column of Table 29. If the number of calves dropped before the cows were sold was different, or the death losses, or the size of the herd, or weight of the cows, or the rate of feeding, the figures would be different. Nevertheless, it is obvious from these data that the cattleman who raises his own feeders has strong inducement to keep them over a second year. He produces beef at the rate of 100 pounds for 870 pounds when he sells two-year-olds at 1,100 pounds, as compared with 980 pounds when he sells calves at 800 pounds.

A strong counterbalancing influence, however, is the fact that the breeding herd is mostly fed on roughage, and on many farms in large part on roughage that would have no other way of being marketed. This is particularly true of nontillable pasture, corn stalks, straw, and rowen. If the ration of the breeding herd were assumed to be worth half as much per T D N as the ration of fattening steers — which no doubt is valuing it too low on many farms — the comparison would in effect be as 660 T D N pounds for the calves and 630 for the two-year-olds. As pointed out earlier, the value of roughages of the foregoing sorts is derived largely from the products obtained from them. Unless they have some alternative use, such possibly as feed for dairy cows, their value is what a farmer can get for them feeding them to beef cattle.

IF FEEDER CATTLE ARE BOUGHT If the farmer is buying his feeders instead of raising them, the analysis needs to be made in terms of the data on gains per 100 pounds of additional feed in the last column of Table 28. The question is that of the age and weight at which to sell cattle purchased as feeders. Then the only overhead which the farmer has in the venture is interest on his investment in the cattle for a few months. Given the price of beef cattle of various weights in different months, and also dependable values for his feed, a farmer can tell at what weight to stop feeding and to sell. Beef-cattle prices vary much less over the year than hog prices. For the years 1926 to 1943, the Chicago price of good-grade steers averaged $11.17 per hundredweight in the two high months, September–October, and $10.32 in the two lowest months, May–June.

TIME OF MARKETING Time of marketing is determined much more by the availability of feed than by prices. Stockmen follow several different systems in this matter, depending mainly upon their location. Some of these systems mean fattening on pasture, usually supplementing the grass with more or less concentrates. In the good blue-grass areas of Kentucky and elsewhere, the cattle may be sold as grass-fattened beeves. The animals fattened may be calves that were fed concentrates during the winter and fed corn freely through the summer to produce baby beef for the late summer or early fall market. Or they may be two-year-olds fed similarly and marketed in July. Or instead, the two-year-olds may be fed roughage mostly during the winter and not go on full feeding till the pastures dry up in July, reaching the market anytime from late September till November, depending upon the amount of corn fed. The winter-feeding systems resemble the foregoing

except that the cattle depend upon the pasture season for their growth and are finished off in the late fall and winter for winter and spring markets. The quality and extent of the pasture largely determines whether summer or winter feeding is practiced. Most Corn Belt land will fatten more cattle growing corn silage than it will growing pasture. There is much land elsewhere on which pasture feeding has the advantage. The winter-feeding systems are more intensive in terms of both labor and capital.

The foregoing analysis has been in terms of steers. Heifers use feed as efficiently as steers, but commonly sell at a small discount in this country.

COMPOSITION OF RATIONS The main problems with beef cattle in composition of the rations are balancing roughage and concentrates in such a way as to get the cheapest gains, and getting enough protein in the cheapest form.[7] On the Indiana farm used earlier as an example, these problems involve the proportions of corn, alfalfa hay, and protein supplement in the ration. The alfalfa used as roughage supplies practically all the protein needed for the beef herd. The 43 tons of alfalfa roughage fed to the 32 feeders is supplemented by 1,200 bushels of corn. This gives a ration which is sufficiently concentrated to produce a rapid rate of gain and put a good finish on the animals. A roughage with less protein in it could replace part of the alfalfa if the farm could produce it more cheaply. The weakness of such rations is that they contain no succulent feeds. Many Corn Belt farmers use a more succulent ration consisting of corn silage and clover hay or clover-timothy hay, than use corn and alfalfa. If steers are given all the corn silage they will eat, they do not ordinarily eat enough hay to obtain the protein they need, even if the hay is alfalfa. Cottonseed meal — 1 to 2 pounds per day — is therefore commonly fed as a supplement.

Two or three hogs per steer is the usual ratio when cattle are fed ear or shelled corn or silage either on pasture or in feed lots. Hogs following yearlings have shown gains in feeding trials of 1.8 pounds per bushel of corn fed the steers, and those following two-year-olds, 2.5 pounds. If they were fed the corn directly, they would gain around 14 pounds per bushel of corn. The corn saved in this way by hogs following cattle may make up a large part of the margin of profit on cattle-feeding operations. This supplementary relationship alone is enough to determine the character of much Corn Belt farming.

[7] Table 1 of the *Recommended Nutrient Allowances for Beef Cattle*, *op. cit.*, also gives the amounts needed of calcium, phosphorus, and vitamin, the last expressed as carotene.

THE FARMING SYSTEM AS A WHOLE

We now need to consider the management problems which we have been analyzing from the point of view of the farm as a whole. The answers that we have been giving thus far have mostly been partial answers. We have been taking these problems out of their settings and looking at them by themselves in order to get a closer look at their details, but we have not yet obtained the final answers.

Also, there are some management problems of such farms that can scarcely be analyzed at all except in terms of farms as a whole. Let us consider some of these first:

1. *Buying feeders* vs. *raising them.* If the Indiana farm kept no beef cattle, it could grow 20 acres more corn and 20 acres more oats by reducing the acreage of hay and pasture. It then could feed as many hogs as now and still fatten 34 more feeders, which would show a gain of selling price over cost of $2,516. Balanced against this would be the loss of $1,944 from the sale of the 9 yearlings and 2 cows. This system, however, would add considerably to the crop-season labor load, and keep the land in continuous cropping. It would use up the plant nutrients in the soil more rapidly and expose it to more erosion. It is doubtful if the yields could be maintained with this cropping system more than five or ten years and after that lower income would follow.

   An alternative that would be less hard on the land would be to convert the 37 acres of rotation pasture to alfalfa. If the cattle ration were left as now, some of the corn now fed to hogs would be needed to balance the extra alfalfa fed to more livestock. The extra 74 tons of alfalfa would feed 50 more feeders, and 2,000 more bushels of corn would be needed. This would reduce the number of hogs sold to 60. The net farm income would be roughly $625 lower, assuming no change in hired labor costs. Additional labor would be involved in harvesting and feeding the hay.

   Or another alternative would be to feed no more corn than now, making the ration consist much more of alfalfa. This would be less profitable, for the cattle would gain less and go to market with less finish and probably sell at a discount of $2 to $3 a hundredweight. The extra alfalfa might be sold for $900 and additional hogs raised on the corn fed the native yearlings. Hog income would be increased $700 but the total farm income would be around $300 less.

   Other alternatives would, of course, be to sell the extra alfalfa as a cash crop; or to buy corn to balance the alfalfa.

2. *Alfalfa* vs. *corn silage.* This farm (and many feed-livestock farms) might use silage for a part of the roughage rather than alfalfa hay. Corn acreage could be increased and alfalfa acreage decreased. The T D N's produced per acre are approximately equal for silage and alfalfa, however, and alfalfa has considerable advantage in protein. In addition, yields of corn and oats would be reduced if a part of the alfalfa acreage is shifted to corn for silage. Net income would be reduced on this farm if silage were used to replace a part of the alfalfa hay. But where yields can be maintained with a smaller acreage in hay and pasture, and corn silage produces considerably more T D N's an acre than alfalfa, net farm income can be increased by using silage as a major part of the roughage in feeding cattle.
3. *Hogs* vs. *cattle.* The central problem on this farm is marketing the roughage. Also 175 hogs are about all that can be raised with the present equipment and labor. A longer-time alternative would be to sell the alfalfa hay now fed to the cattle and feed all the grain to hogs. Hog and alfalfa sales would be increased around $3,800, but cattle income would be reduced $4,300 — a net reduction of $500.
4. *Fattening calves,* vs. *yearlings,* vs. *two-year-olds.* The final answer to this question also cannot really be given except in terms of the farm as a whole. If the 9 calves on the Indiana farm were sold as baby beeves at 14 months of age instead of carrying them over the second summer and winter, 9 acres of pasture and 15 tons of alfalfa hay would be released for some other use. About the same amount of corn would be used, but the baby beeves would average only 850 rather than 1,130 pounds, and the 9 would sell for $408 less. Six more cows and 5 additional baby beeves could be raised on the roughage released, but this would require a reduction of 11 hogs to obtain the corn to fatten them. On balance, the cattle income would be increased around $300 and hog income decreased $385.
5. *One* vs. *two litters per year.* This farmer might reduce his spring farrowings to 115 and raise 60 fall pigs as a second litter from 10 sows. The determining factors in such a decision are the availability of clean pastures and warm quarters for fall pigs. The shift of 60 pigs from spring to fall would reduce pasture requirements three acres and feed inputs enough to fatten 6 extra pigs. The net gain from such a shift would be $225. While more labor is required to raise the same number of pigs in two bunches, the peak-labor load in the spring would be reduced and additional profitable employment provided in the winter.

6. *Buying feeder hogs* vs. *raising them.* Feeder pigs might be purchased to follow the cattle and eat up the surplus corn instead of farrowing them on the farm. This would reduce the labor load in the spring and save the need of housing for sows at farrowing time. In years when the hog-corn ratio is unfavorable, feeder pigs can be purchased more cheaply than they can be raised. Usually, however, this is not true. The deciding factor for most farmers is the difficulty of buying disease-free feeder pigs. Many farmers refuse to buy any feeder pigs, even though they have surplus corn some years because of the danger of bringing diseases onto the farm.

These six sets of alternatives by no means exhaust the list of those on corn-hog-cattle farms that need to be analyzed in terms of farm businesses as a whole. In other parts of the Corn Belt especially, such problems as the following are important:

1. Summer *vs.* winter fattening of cattle.
2. Heavy *vs.* light feeding of two-year-olds during the winter, to reach the market in July or in September–October.
3. Heavy or light feeding of cattle on pasture.
4. Alfalfa in a corn-oats-clover–timothy rotation.
5. Dual-purpose *vs.* beef breeds.

C. *CORN–HOG–DAIRY FARMING*

The Corn Belt areas which we have just been considering mostly obtain less than a fourth of their incomes from milk and cream. The dairy-farming areas discussed in Chapter XI ordinarily obtain less than a fifth of their income from hogs. South of the dairy areas shown in Chart 44 of Chapter XI and on the northern fringe of the areas shown in Chart 42 in Chapter X, is a band of territory where dairy farms are plentifully intermingled with the corn-hog-cattle farms, and as much of the farm income is obtained from the dairy herd as from sales of hogs or fat cattle. These farms have more pasture and grow more hay than those discussed in Part B. Their land is, in general, not so fertile or so nearly level, but it grows grasses and clover very well. Soils scientists have frequently observed that the Gray-Brown Podzolic soils found in much of this territory seem to support a high order of agriculture.

Corn is still the most important crop on these farms, but in general a larger fraction of the corn is put into silos than in the Corn Belt. Enough is harvested for grain, however, to fatten a few loads of hogs spring and fall. The two-litter system followed means that growing pigs are at hand to consume the skim milk at all seasons. Until the war provided

a new market for skim milk powder, most of the milk was sold as cream to creameries making butter. The cheese factories, which use whole milk, are located farther north. The milk condenseries are likely to be located either farther north, or on the edges of city milksheds. Formerly, many of the herds of these areas were of dual-purpose type, usually Shorthorns or "native" red cows. The farms would shift from milk to beef if beef prices were higher, merely by changing from milking the cows to letting the calves do it; and in the opposite direction if milk prices became more favorable. Today, a majority of the herds are of the Holstein breed, and the balance is between raising heifer calves, keeping more cows, and raising hogs.

The management problems of these farms are in general the same as those for the dairy farms and corn-hog-cattle farms considered in this chapter, except that the greater diversification, frequently between three main enterprises in place of two, on the one hand offers a better chance for full use of the factors of production, and on the other hand offers more chance for conflict. The working hours on the farms in this group are among the longest on farms in the United States. During the crop season, chore labor both morning and night is combined with a full day in the field.

An important poultry enterprise has been developed on many of these farms. Young chickens are raised on clean ground by the women folks and placed in the laying house in September or October. Increasingly the houses are insulated for warmth in the winter and high egg production is maintained during the winter months. The poultry flock, when well managed, provides profitable employment for more labor than when the same feed is used for hog production. Poultry returned more above feed costs than other classes of livestock over the several years just before the war.

In Table 30, data are presented for five counties which exemplify the corn-hog-dairy combination. In the first, more of the farms were classified as animal-specialty (meaning hogs and/or beef cattle) than as dairy in 1929; in Grant County, the dairy farms were somewhat the more numerous; and in Steele County, they were clearly dominant. In Winnebago County, on the Wisconsin boundary in Illinois, and halfway across the state, the two types of farms are about evenly balanced. All of these counties have a good many general farms, that is, farms in which neither the dairy or the other livestock income quite adds up to 40 per cent. Both together, however, contribute 66 per cent in Branch County, on the southern Michigan boundary.

The income from meat animals, mostly beef cattle and hogs, ranged

from 47 per cent of the total in Clayton County in 1929, to 32 per cent in Steele County and 28 per cent in Branch County. The proportion of the income from livestock products, mostly dairy, ran in the opposite order, from 36 per cent in Clayton County to 46 per cent in Steele.

The animal-specialty farms run larger than the dairy farms and have a larger value of product. They have fewer cows per farm than the dairy farms reported in Chapter XI, but somewhat more other cattle and definitely more sows and gilts. The animal-specialty farms in these counties obtain from 57 to 67 cent of their income from livestock, and from 20 to 29 per cent of it from livestock products. On the dairy farms, these proportions are almost reversed.

The crop acreages declined very little in these counties in 1929 to 1939 in spite of crop control. Corn acreage declined only in Area 268. Soybeans replaced around 5,000 acres of oats and barley in each of these counties. Hay acreages were well maintained. Cattle numbers increased in all the counties, and hog numbers in all except Clayton. Crop yields were improving and tractors were being substituted for horses. Crop acreages and livestock production were expanded still further during the war.

The special management problems of these farms introduce no new principles, but it will be helpful to list some of the more important of them and analyze them very briefly:

1. *The balance of the hog and dairy enterprises.* Where hogs and dairy cows are the only two important enterprises on the farm, the enterprises should be brought into balance in the following manner: (a) Develop a cropping system which maintains the productivity of the soil, yet produces as much corn and legume hay as possible. (b) Adjust the size of the dairy herd to consume the hay, pasture and silage produced by such a cropping plan. (c) Feed the dairy cows grain to the highest-profit level as determined by the price of milk and grain. (d) Keep enough hogs to market the remainder of the grain.
2. *Raising heifers* vs. *milking more cows.* Farms which market cream rather than whole milk have a choice between raising all the heifers and selling surplus cows to city milkshed areas and keeping a larger milking herd. Young growing cattle require large amounts of pasture and roughage in relation to concentrates. Less labor is required to market roughage through growing young cattle than through a milking dairy herd. But unless one has a surplus of cheap pasture or has low-producing cows, it will not pay to reduce the milking herd to raise additional young cattle for sale.

TABLE 30. THE ORGANIZATION OF CORN-HOG-DAIRY FARMS IN FIVE SELECTED COUNTIES, 1929

	N.E. Iowa	*S.W. Wis.*	*S.E. Minn.*	*N.E. Ill.*	*S. Mich.*
Type number of area	268	268	262a	272	312
Combination	Hogs Dairy	Hogs Dairy	Dairy Hogs	Hogs Dairy	General Dairy
Percentage of land in area in:					
Crops	61		61	52	61
Pasture	32		31	41	25
Hay	14		17	17	13
Corn	27		16	23	13
Small grain	19		17	15	16
Percentage of farms:					
Dairy	18	42	58	30	19
Animal-specialty	51	27	6	32	15
General	22	20	27	14	42
Crop-specialty or cash-grain	—	—	—	4	5
County	Clayton Iowa	Grant Wisconsin	Steele Minnesota	Winnebago Illinois	Branch Michigan
Number of farms in county	2,992	4,087	1,925	1,928	2,750
Dairy farms:					
Number	533	1,732	1,114	588	516
Value	$15,276	$12,335	$13,100	$18,431	$7,045
Total acres	149	169	144	139	116
Crop acres	74	73	96	103	60
Total value of product	$2,770	$2,810	$2,820	$3,050	$2,150
Number of:					
Milk cows	12	13.9	12.5	10.5	7.6
Beef cows	0.2	0.2	0.0	0.1	0.1
Other cattle	12.1	14.9	9.5	10.0	6.9
Sows and gilts	7	6	6	6	1
Feed expenditures	$170	$190	$95	$175	$195
Percentage of income from:					
Livestock products	53	50	50	54	60
Livestock	31	35	31	32	21
Crops	1	2	5	6	8
Animal-specialty farms:					
Number	1,537	1,091	528[a]	610	1,168[a]
Value	$20,303	$16,849	$12,217	$20,136	$5,783
Total acres	183	209	134	191	108
Crop acres	96	109	89	124	57
Total value of product	$3,500	$3,560	$2,410	$3,910	$1,580
Number of:					
Milk cows	10.9	9.2	9.2	6.9	3.9
Beef cows	.8	3.1	.1	1.6	.1
Other cattle	15.8	21.2	7.9	13.6	3.8
Sows and gilts	12.6	14.4	5.0	10	1
Feed expenditure	$190	$250	$77	$250	$87
Percentage of income from:					
Livestock products	29	27	40	20	35
Livestock	57	60	31	67	26
Crops	2	2	13	6	19

[a] General farms.

D. *FEED-LOT FARMING*

The farms which we have been considering in Parts A, B, and C of this chapter have in the main been farms which raise the livestock which they feed and grow the feed for this livestock. The principal exception has been the Indiana farm which bought most of its feeders. All told, a good many farms scattered widely over the country raise more young cattle than they can fatten with their own feed, or more feed than can be fed to the stock they raise. We shall have occasion to refer to these in several connections later in the book, but a little general analysis is needed at this stage.

Not all of the farms with more roughage than grain sell their young stock as feeders. In some sections of the country, they are near enough to cash-grain areas to be able to afford the trucking or freight costs of grain. Thus, south central Iowa and northern Missouri have several counties of land so rolling that only a small fraction of it can safely be planted to corn. There are similar areas eastward to southern Ohio. Generally speaking, the farms are smaller in these counties than on the level lands, which means that additional farm enterprises are much needed.[8] No principles of organization are involved that have not already been discussed. The amount of feed bought can be fitted exactly to the number of cattle or hogs that can be handled.

The usual surplus on Corn Belt livestock farms is feed rather than young stock. Since the transport costs for livestock are less than for grain, it is economical to convert the feed into meat on the farms where the feed is grown, especially if the livestock can be unloaded and fattened on their way toward eastern markets. The annual movement of stockers and feeders through public stockyards in the years before the war were as follows: cattle, 2,900,000; calves, 530,000; hogs, 450,000; sheep and lambs, 3,100,000.

Other than problems relating to the production of feed and forage for such livestock, the only problems left to discuss are those having to do with price differentials and with types and qualities of stockers and feeders. Feeder cattle and hogs have different seasonal price movements from fat cattle. Feeder calves and steers and heifers have generally been about $1.00 a hundredweight cheaper in October–November than in April–May, whereas fat steers have sold from $1.00 to $1.50 more at their September–October peaks than in their weak markets in May–June. But the seasonal variation may be either more or less than this in

[8] North of the cash-grain sections, farms on the rolling lands are likely to expand their dairy enterprises instead of buying feed to fatten more cattle and hogs.

individual years, depending upon the size of the corn crop and the number of feeders coming off the ranges.

IMPORTANCE OF MARGINS "The profit in feeding cattle is made or lost when the cattle are bought" is a common saying. Profitable feeding operations with purchased cattle require a substantial "margin" in the sale price per hundred pounds over the purchase price. Unless this margin is realized, the feeding operation will be unprofitable regardless of the fattening ration fed. Usually a margin of $3 to $5 per hundred is required for the profitable feeding of cattle to a high state of finish. Chart 48 and the data in Table 28 show that the additional gains per hundred pounds of feed fall off more sharply in the last stages of finishing older cattle than in fattening calves and yearlings or in bringing thin animals to a moderately fat condition. The margins required therefore depend on the age of cattle fed and the degree of finish put on them. Calves weighing 400 pounds can be fed out at a profit without any gain in the sale price over the purchase price per hundred pounds. Yearlings require only a moderate margin.

When cattle are high priced and feed is relatively cheap, less margin is required than when the situation is reversed. The 800 pounds of grain, plus the roughage required per 100 pounds of gain in two-year-olds, cost around $13 when corn is 84 cents a bushel, or $1.50 per hundredweight, with roughage prices in proportion. Given a feeder steer weighing 750 pounds and costing $6 per hundredweight, a margin of $2.00 per hundredweight would be needed to add 300 pounds of weight.[9] If the feed cost $1.00 per hundredweight, a margin of only 60 cents would be needed for adding 300 pounds to 750-pound steers. If the feeder cattle cost $9 a hundredweight, a margin of $1.14 would be needed.

SEASONAL FACTORS It is obvious that the size and quality of the feeders purchased need to take account of the amount and type of roughage to be fed. It is equally important to adapt the quality of cattle handled to the time of year they are to be ready for market. In particular, common or low-grade feeders should not be grain-fattened for the fall market, since grass-fattened cattle are coming to market in large numbers at that time and little if any premium is paid for low-quality grain-fed cattle. It is choice and prime cattle that are highest in the fall.

The usual cattle feeder fits his cattle for the late winter and early spring market, partly to avoid the extra labor of caring for fattening cattle

[9] Cost of steer = $45. Cost of feed = $39. Total = $84. $84 ÷ 10 5 hundredweight = $8.

during the summer when he is busy with his crop work, and partly because prices are usually higher at that time for the quality of cattle he has to sell, and relatively lower later for cattle in high finish, because of the large number of well-finished cattle coming to market later. In contrast, the demand for thin cattle to put on pasture is strong in the spring months. Low-quality cattle should be fed for the April to June market whenever possible. If one is feeding for the fall market, *usually it will pay to buy higher-quality feeders than for the spring market.*

All cattle feeders, whether they buy or raise their cattle, have the same problems of deciding how much grain to feed per day and how long to feed their fattening cattle. Fattening cattle is unlike feeding either hogs, dairy cattle, or poultry. The marginal analysis outlined earlier can be applied to determine when to send a particular bunch of cattle to market if there are alternative uses for the feed. But if the main object is to have the fattening cattle consume the otherwise unmarketable roughage, the feeding program will be planned differently than if the cattle are to be fully finished in the shortest possible time. The grain can be limited and the cattle will make economical gains while consuming relatively large quantities of roughage. When fed all the grain they will eat, fattening cattle consume very little roughage. The cattle-feeding program on most farms is planned to utilize both the extra roughage and extra grain. But toward the end of the feeding period, the shrewd feeder watches his cattle and the market carefully and adjusts the finish which he puts on them to the amount of premium being paid for well-finished cattle that year.

Feeder and stocker cattle vary greatly in condition. Some of them are thin and even stunted, especially in dry years on the ranges, while others are half ready for the block. The temptation of the good cattlemen is to buy the feeders that are in the best condition. They may not, however, take on weight as rapidly as the thinner animals. Difference in breeding and conformation are of another nature. The steer with a blocky beef-type build will sell at a better price when fat.

LAMB FEEDING Lambs are fed in many areas, mostly west of the Mississippi River, but the major feeding areas are in western Nebraska and eastern Colorado. In the irrigated valleys along the Platte and Arkansas Rivers, well over a million lambs are fed each year. Lamb and steer fattening are here combined with mixed cash-crop farming. An important factor in lamb fattening in these irrigated areas is wet beet pulp, a by-product of sugar-beet production. Lambs weighing about 60 pounds are purchased in October, and are commonly pastured

for a short time on beet tops, a nutritious feed, or upon other crop aftermath. When put into the feed lot, they receive alfalfa and a little barley at first along with the beet pulp. The barley ration is gradually increased, and then corn is substituted for it as new-crop corn becomes available. In 120 to 150 days the lambs are sold, usually weighing about 90 pounds.

For a feeding season of 135 days and a gain of 27 pounds per head, an average of 180 pounds of alfalfa, 66 pounds of corn, 40 pounds of barley, 105 pounds of wet beet pulp, and 38 pounds of other feeds were fed on a group of lamb-feeding farms in Colorado.[10] Average daily gains per head range around 0.20 of a pound. A margin of 1 to 2 cents per pound between purchase and sales price is necessary if all costs are to be met. This margin is partly due to improved grade of the lamb, and partly to normal seasonal price movements. If they are to avoid severe price decline, the fed lambs must move to market ahead of the early spring lambs from California. Faster gains, up to 0.25 of a pound or more per day, are more economical of feed, but may bring the lambs to market too early for the best seasonal price.

The feed-in-transit privilege is an important factor in lamb feeding. Freight is paid to some central market when the lambs are shipped from the area where they are raised. They are unloaded, fed, and reshipped later at only a slightly added transportation cost.

Lamb feeding fits well into the organization and operation of these irrigated farms. Alfalfa, barley, and other feed crops must be grown in the rotation with the sugar beets to check the ravages of the sugar-beet nematode and other pests. Lambs provide a good market for these feeds and for the beet pulp and provide winter work. But lamb feeding, like cattle feeding, is subject to wide fluctuations in returns. The skillful feeder, with assets enough to weather an unprofitable season or two, earns a good income from it over a period of years.

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EXERCISES

1. Find the average weight of hogs marketed in St. Louis, Omaha, and Chicago and explain the differences found in terms of the different systems of farming in the areas sending hogs to the three markets.
2. Under what circumstances will it pay a corn-hog-cattle farmer to put gains on hogs at the maximum possible rate? Under what circumstances will it pay better to put gains on more slowly?
3. Using the Indiana corn-hog-cattle farm described in this chapter, set up complete farm budgets (1) producing 200-pound market hogs in as short a period as possible, (2) producing 200-pound market hogs in approximately 50 per cent longer time, (3) producing 300-pound market hogs as quickly as possible, and (4) producing 300-pound market hogs in approximately 50 per cent more time.
4. What are the most important factors influencing the farm-to-farm variation in weight of hogs marketed in the South?
5. Discuss the circumstances which make it more profitable for a Corn Belt farm to buy rather than to raise feeder cattle. Same, to raise rather than to buy them? In addition to factors on the farm, what factors of the farm family might effect these decisions?
6. Assume three sets of prices of feeder cattle and costs of feed and calculate the margins that will be needed to cover costs.
7. In what ways can the price risks inherent in buying steers for feeding be minimized?
8. Why do eastern Corn Belt farms not fatten lambs more generally than they do?

CHAPTER XIII

Crop-and-Livestock Farming

In this book we shall use the term crop-and-livestock farming to refer to farming that combines significant amounts of cash-crop and livestock production; and we shall devote two chapters to analyzing it. In the 1930 census classification of types of farming, such farms are more often called general farms than anything else. This means that the balance between the livestock and the cash crops was so nearly even that the receipts from neither equaled 40 per cent of the total. We shall consider many farms as crop-and-livestock in these two chapters, however, which were classified as cotton, or crop-specialty, or cash-grain, or even truck or fruit farms because the receipts from one of these sources did total up to 40 per cent. Many of them also had significant amounts of income from livestock. For similar reasons, we shall classify as crop-and-livestock some which were classified in the census as dairy, or animal-specialty, poultry farms, or cattle or sheep ranches. The 1930 census classified 1,044,000 farms as *general*. Probably two to two and one-half millions practice crop-and livestock farming as this term is here used, and over two hundred of the areas and subareas. We are therefore dealing in these two chapters with the largest group of farms thus far considered. We shall be able to deal with them briefly, however, since they introduce only new applications of principles already discussed.

The geographical distribution of crop-and-livestock farms is roughly the same as that for the general farms in the census survey. They are found in considerable numbers in all parts of the country except the heart of the Cotton Belt and the more arid sections of the Great Plains. One large concentration of such farms occurs in the southeastern half of Minnesota, where small grain and corn are sold for cash but also fed to livestock. A small concentration in central Wisconsin represents a combination of either potatoes or tobacco with dairy farming. The southern half of Michigan is a maze of general farms growing a combination of small grains and corn, fruit and truck, and even field beans, along with dairy farming or hogs or even some beef cattle. The most

concentrated group of general farms stretches from southern Michigan down through to the southern border of Ohio and Indiana and swings around to take in the southern third of Illinois. Here the combination is of corn and/or wheat sold for cash with hogs, or with beef cattle, or with dairy farming near the cities. Nearly all of the whole state of Missouri, except the bootheel, is given over to general farming more than to anything else, but many of the general farms have crop combinations with not much livestock. Missouri is the meeting ground of grain farming on the west, corn-hog and beef-cattle farming on the north, and cotton farming on the south.

A good many general farms are also found in central Kentucky and in Tennessee, a region with excellent grazing, but also lending itself to the growing of corn and winter wheat, and tobacco in many sections. The Eastern Valleys of Tennessee combine dairy and beef cattle and hogs with corn, wheat, and tobacco. The South has relatively few general farms according to the census definition, because ordinarily the income from livestock on these farms does not amount to 40 per cent of the total; but a good many of them get enough livestock income to qualify under our definition of crop-and-livestock farms. This is also true of much of the Great Plains, and of areas on the Pacific Coast like the Willamette Valley. The general farms of New England are those which combine potatoes, tobacco, fruit, or truck crops with dairying.

The farms classified as general in the census tend to be smaller in terms of product than the other principal types except cotton. Their value of products averaged $1,480 in 1929 for the country compared with $2,760 for dairy, $2,940 for cash-grain, $3,600 for animal-specialty, and $1,030 for cotton. This is partly because the general farms tend to be located in the lower-income parts of the country, and on the poorer lands of other sections. With a few important exceptions, they are most prevalent in the poorer-land parts of the Midwest. In some areas, these farms become general because the family tries to enlarge its income by growing an intensive cash crop as a supplementary source of income; in others, because of adding livestock to use up the forage growing on land too rough to cultivate. Adding a sizable poultry enterprise may have the same effect. On small farms, the value of farm products consumed by the family often amounts to a fifth of the total, and when the poultry receipts are added to this, less than 60 per cent may be left to divide between cash crops and livestock.

Farms of this description commonly offer a complete set of all of the supplementary, complementary, and joint-product relationships that have been introduced in the preceding chapters. These present no new

enterprise relationships, but highly varied forms of the familiar ones. The distinction between major and minor enterprises often becomes important on such farms. Very frequently such farms take on a minor enterprise because it fills in a small gap in the year's round of labor, or offers additional employment for family labor. Enterprises which have a generally supplementary relationship to others but are minor in character are referred to in common parlance as *sidelines*. Similarly, when one of the joint products is relatively unimportant, like corn stalks or straw, it is referred to as a *by-product*. When they are more nearly equal in importance, they are simply called *joint products*. Examples of this sort are the beef and milk from dual-purpose herds of cattle, and the wool and mutton from some dual-purpose flocks of sheep. An interesting type of this relationship is found on farms in the border states which breed dairy cows, principally Jersey, to beef-type sires and sell the calves for meat when weighing five to eight hundred pounds. Most commercial poultry farms today are either for egg production or broiler production, but many farm flocks are still of the dual-purpose type. In some sections of the United States during the war, the cottonseed has been almost as important as the cotton, but normally the cottonseed is a by-product of cotton.

Crop-and-livestock farming, it should be apparent, has some very important advantages. (1) The chief of these is an opportunity for fuller employment of land, labor, and equipment. (2) More of the land is usually kept in grass and sown crops. (3) The farm income is more stable. (4) Disease hazards are less in diversified than in the highly specialized areas. The disadvantages are that with several enterprises, only an unusual farmer is likely to be skilled in handling all of them, and that the small volumes produced on such farms may not be well marketed. We shall observe the relative weights of these advantages and disadvantages as we proceed from one type of farming to another in these two chapters.

The crop-and-livestock combinations considered in these two chapters, although they take a wide variety of forms, may be roughly classified under five heads: (a) Largely cash-crop farms with some livestock production. Such a combination arises when the single-crop farms discussed in Chapters VII and VIII add some livestock production. The most conspicuous combinations of this type are the cash-crop cotton and tobacco farms of the South, and the cash-grain farms of the Great Plains, that have added a certain amount of livestock production. (b) Livestock farms that have added a certain amount of cash-crop production. These are widely scattered over the Great Plains from Texas north,

the usual combination being livestock and cotton or livestock and wheat. (c) Largely livestock farms which persist in growing some cash crops. These are found mostly interspersed among the livestock farms of the Corn Belt. (d) Farms in which livestock and cash-crop production are in somewhere nearly even balance. These also are most prevalent in the Corn Belt. Others are found in eastern parts of the Great Plains. (e) Farms which combine livestock with fruit or truck crops rather than with field crops. These are found in the fruit- and truck-growing areas, or more often on the edges of them, all over the country. By no means is all fruit and truck-crop production completely specialized. Such farms are most common in the areas where truck crops are grown for canning. The discussion following is in the order of the foregoing.

THE DIVERSIFICATION OF CASH-CROP FARMING

Let us begin our analysis by considering the effects of introducing livestock into the four one-crop systems of farming studied in Chapters VII and VIII. Given the relative levels of prices for potatoes, dairy products and beef that prevailed before 1930 in Aroostook County, Maine, and the present techniques of production, no mixed system of farming would return as much per acre or per farm as did one-crop potato farming, on the soils that are well suited to potatoes. The potato prices prevailing in the 1930's scarcely supported the potato growing that was practiced, but dairy farming would have yielded still lower returns per acre. If, however, the competition of other potato areas lowers prices much below the 1925–1929 level, the less adapted farms will profit by shifting to a rotation system that includes enough hay and small grain to support a dairy enterprise. Probably it will also pay to harvest the clover crop now plowed under, feed it, and return it to the soil as manure. Dairying is handicapped in this area by the high cost of feed and the long distance from any large fluid milk market.

The wheat area studied in Oregon-Washington would improve greatly the distribution of its labor if it would combine ranching with wheat, but it cannot afford to do this even at the rainfall and price levels of the thirties. Prolonged drouths and depressed prices would, however, cause some borderline fields to be abandoned until the next series of wet years came along. To the east in the Palouse Area, the land has considerably more relief and its rainfall is enough higher so that peas, sweet clover, and perhaps other forage crops can be grown. Although erosion does not rob the Palouse soils of their fertility in the usual way, it gullies the land and makes difficult the use of tractors and combines.

This area may therefore expand its present small cattle enterprise over the years.

With as many people to support as are now living there, the Black Prairie of Texas cannot afford to grow feed for commercial livestock enterprises, except as these may prove necessary in turn to save its land from the fate that has befallen the Black Belt of Alabama and Mississippi. Methods are being developed that will partly control the erosion. It will take heavy migration, high wages, and mechanization to shift this area rapidly out of cotton farming.

FLUE-CURED TOBACCO FARMS, CASWELL COUNTY, NORTH CAROLINA The 2,600 tobacco farms in Caswell County have a different prospect than the foregoing.[1] They can add livestock production without reducing their tobacco acreage. These 2,600 farms, it will be remembered, averaged only $36 of livestock income, including poultry, in 1930. The reorganization worked out in Chapter VIII produced some wheat, oats, and lespedeza for sale as a cash crop, and added 6 acres of improved permanent pasture. This extra feed will support enough more livestock to increase the livestock income from $15 to $150. This gain, combined with that from larger crop sales resulting from fuller use of the land, promises, at prewar prices, to add $450 to the net cash income of the farm analyzed in Chapter VIII. This would be a two-thirds increase. Similar reorganizations worked out for five other small and medium-size tobacco farms in Caswell County in 1940 promise to increase the livestock incomes by amounts ranging from $61 to $180 per farm, and total incomes by amounts ranging from $164 to $382. The tobacco acreage is left unchanged, but yields are expected to improve a little because of better treatment of the land under the new systems. The additional labor called for by these reorganizations mostly comes at times when it does not conflict with the tobacco.

The capital outlay to make the changes on the sample farm would be $290, consisting of $150 for a mower and rake with a seed-pan attachment, $48 for sericea and other seed, $74 for fertilizer and lime, and $18 for fencing materials. These would be spread over four years. It would be smaller on some of the other farms.

COTTON AND LIVESTOCK, SELECTED COUNTIES, 1929 Conversion of Southern cotton farming to crop-and-livestock farming has had strong advocacy for two generations at least. Table 31 presents data for five type-of-farming areas combining cotton and livestock in 1929. These

[1] Robert E. Graham, Jr., *Improving Low Incomes on Tobacco Farms, Caswell County, N. C.*, U.S.D.A. Washington, D. C., 1941.

areas are selected to show the range of conditions under which such a combination was being made in 1929. They include most situations of this kind of any importance anywhere in the South.[2] Even to obtain this much of an exhibit, two areas had to be taken in which only 12 per cent of the income was from livestock and livestock products combined (excluding poultry). The Black Belt of Alabama and Mississippi at this time was obtaining only 23 per cent of its income from livestock sources. Only in the two Texas areas was the livestock income about as important as the cotton income. The Western Cross Timbers area has light soils and thin scrubby timber. The other is in the Coastal Prairie section of southeastern Texas. The Georgia area combines tobacco and peanuts with the cotton and a small amount of mixed livestock production. The values of product of the general farms in these areas — and these are the ones with the most livestock — are only $100 to $300 higher than those of the cotton farms, but so low is the prevailing level of productivity in these sections that this may mean a third more income.

The productivity of these counties did not increase between 1930 and 1940. The cotton acreage declined pretty much as elsewhere, and was only in part replaced. In Erath County in the Western Cross Timbers, cotton in 1930 occupied a half of the total crop acres; in 1940, only an eighth of it. Forage production — hay, cowpeas, oats — and peanuts, increased only a third, and the corn acreage not at all. The rest of the cropland must have reverted to pasture and brush. The number of milk cows increased around 3,000 and of sheep around 24,000 — 2.5 and 23 per farm respectively.

In the other Texas county, the decline in cotton acreage was only two fifths. Peanuts declined more than cotton. Corn and sorghum increased enough to make up for only one fourth of these declines. The hay and forage increases were small. The herds of cattle, mostly beef, increased a tenth. The productivity of the pasture and hay crops limit livestock production in such areas.

In Lowndes County in the Black Belt of Alabama, the cotton acreage fell off a half and the corn acreage by a fourth. The offsetting gains in forage crops (hay, cowpeas) made up only a fourth of the losses. The number of cattle increased an eighth only.

In the Georgia county, the total crop acreages increased, although cotton declined a half. Big increases occurred in corn and peanuts, and with these an increase of a tenth in cattle and hogs.

[2] Excluded, of course, are the essentially cattle-ranching areas of southern Florida, or of the savannahs of the coastal plains of the Carolinas and Georgia especially.

TABLE 31. COTTON-LIVESTOCK FARMS IN FIVE SOUTHERN COUNTIES, 1929

	Western Cross Timbers Texas	*Texas Upper Coast Prairie*	*Alabama Black Belt*	*S. Georgia Coastal Plain*	*North Carolina Piedmont*
Type number of area	218	257b	341a	470c	462
Percentage of farm land in:					
Crops [b]	35	35	43	47	41
Pasture	66	63	38	22	14
Corn	6	9	13	19	9
Cotton	9	18	21	10	8
Peanuts	4	6	—	23	1
Tobacco				10	
Percentage of farms:					
General	20	12	7	24	22
Crop-specialty	1	0	0	14	0
Cotton	55	70	77	39	40
Animal-specialty	3	1	1	2	1
Dairy	2	1	2	—	2
Self-sufficient	3	—	5	3	16
Percentage of income from:					
Cotton	31	33	50	29	47
Livestock	27	21	9	16	5
Livestock products	8	3	14	2	7
Family living	16	23	17	15	28
County	Erath Texas	Colorado Texas	Lowndes Ala.	Thomas Ga.	Chatham N. C.
Average farm:					
Total acres	208	170	69	112	97
Value of farm	$4,600	$4,900	$1,400	$4,500	$2,000
Value of products	1,250	870	740	1,310	650
Value of equipment	300	360	90	150	140
General farms:					
Value of product	$1,120	$990	$790	$1,260	$840
Number of milk cows	3.9	5.5 [a]	4.0	1.5	2.1
Number of other cattle	9.3	13.7	5.9	3.5	2.1
Number of sows or gilts	0.2	0.3	0.4	1.7	0.5
Cotton farms:					
Value of product	$970	$740	$660	$1,130	$580
Number of milk cows	2.6	2.3 [a]	1.5	0.8	1.2
Number of other cattle	4.5	7.3	2.4	1.8	0.9
Number of sows or gilts	0.1	1.8	0.4	1.2	0.2

[a] Beef cows
[b] Some land is double-cropped, or both cropped and pastured.

The piedmont county of North Carolina exchanged a loss of four fifths in cotton for a gain of a half in tobacco plus small gains in cowpeas and a tenth in livestock.

The changes during the war in these counties were in the same general direction so far as acreages were concerned, with more emphasis on peanuts, but yields were better and output larger.

Agriculture, except in the Georgia county, would appear generally to have declined in areas of this type. The reason for this is that the yields of cotton and corn are so low that they no longer support a cotton type of farming. The soils tend to be sandy, highly erosive, or deficient in other ways. The coming of the boll weevil earlier started the shift out of cotton. The shift toward living somewhat more from livestock has therefore been forced upon the people.

SOUTHERN PIEDMONT — GREENE COUNTY, GEORGIA The farm that we will use to show the nature of the problem of diversifying a piedmont cotton farm is located in Greene County in east central Georgia. This part of the South was hit hard by the boll weevil in the twenties, and some counties lost nearly half their population. As methods of weevil control developed — planting earlier varieties, and dusting — the cotton acreage became stabilized again, but at a lower level. The income from livestock and livestock products including poultry in 1929 was only 17 per cent of the total. Four fifths of the farms were classified as cotton. Between 1930 and 1940, the cotton acreage was reduced a third, its place being taken by hay, corn, cowpeas, velvet beans, and oats, in the order named. Numbers of livestock were increased only moderately.

This particular farm has 46 acres of cropland, large enough for two mules.[3] It is therefore classified as of medium size in this region. It has 22 acres of pasture and 50 acres of woodland, and a total of 120 acres. Its crop acres in 1939 were divided as follows: cotton, 10; corn, 6; corn and cowpeas, 5; corn and velvet beans, 6; wheat, 4; oats, 3; cowpeas, 6; idle, 6. Its livestock consisted of 2 cows, 1 sow, and 25 chickens. Its total cash receipts, reckoned at average 1935–1939 prices, were $335 (not including $74 of A A A payments), divided $245 for crops, $60 for livestock, and $30 miscellaneous. Its total cash outlays were $120, of which $72 was spent for fertilizer. Out of the net cash income of $215, plus the $74 of A A A payments, this farm had to maintain buildings, fences, and equipment, and provide the family living not supplied by the farm.

[3] This discussion is based on Georgia Bull. 221, *Farm Adjustment Opportunities in Greene County, Georgia*, by M. C. Conner, W. E. Hendrix, C. R. Sayre, and W. T. Fullilove, 1942.

Two alternative organizations proposed by the group that studied this farm left the total acres of cropland and pasture as at present and made no change in the cotton acreage. They increased the livestock income to $270 and $390 respectively, however, by using all the idle cropland, establishing 8 acres of kudzu as permanent hay and forage, combining velvet beans with all the corn, increasing the oats acreage to 10, and double-cropping 16 acres with lespedeza and common white clover and rye grass. This additional feed made it possible to keep 12 beef cows in the reorganization giving $270 more livestock income, and 9 milk cows in the one giving $390 more livestock income. The rotations proposed consisted of cotton the first year, winter oats followed by lespedeza and then winter legumes for the second year, and corn and velvet beans for the third year; or a four-year rotation with an extra year of either the winter-oats or the corn-bean combination. The calves are weaned at around 200 pounds and ordinarily sold as yearlings, with corn, velvet beans, and cottonseed meal being fed as concentrates. The investment in equipment and livestock would be raised to around $500.

Five years or more should be taken to reach this new level of productivity. Kudzu has to be established by setting crowns, which are most cheaply obtained by plowing them out of a kudzu field already established. A beef cattle herd can be raised more cheaply than it can be bought.

The question may be asked whether increasing the cotton acreage to fifteen and keeping slightly fewer cows, once these other changes had been made, would not pay better than the two plans proposed. It would, if cotton prices could be maintained with other growers doing the same thing. And prices may not even be maintained at prewar levels as competition with other areas, other countries, and other fibers develops further.

If cotton prices do decline, can the piedmont areas of the South afford to shift further toward livestock and away from cotton? Reducing the cotton acreage from ten to five on this Greene County farm, substituting winter oats for it, would cut the gains from the reorganization by about $40 at prewar levels of relative prices. Cotton prices would, therefore, need to fall very little before the five acres of cotton would pay better than ten.

Although these reorganizations would add importantly to the farm family income — $270 added to $335 would surely be a welcome addition, and $390 would be still better — still they do not raise the farm incomes to the levels of those of farm families in many other regions. Further steps are necessary for that. One is to enlarge the farm; another,

to improve more of the land and thus make it more productive. These two may in effect be substituted for each other. They may also be combined. If another 80 acres of land that included 23 tillable acres were bought or rented and planted to the same feed crops as now grown on the farm, but the enlarged farm was shifted fully to a four-year rotation, and 4 more acres of kudzu were established, this farm would carry 11 more head of beef cows, or 8 or 9 more milk cows.

This change would mean, of course, less cotton on the 200 acres than under present management; and if this sort of move were made generally, it would reduce the number of jobs in the area, since feed crops use much less labor than cotton. But low cotton prices may force some of the population to move out of the piedmont areas in the next decade or two, just as the boll weevil did in the 1920's. The cotton acreage could be increased from 10 to 12 on farms enlarged in this way and still the cotton acreage would be reduced a fifth in the county.

The farm which we have been analyzing is considered to be a medium-size farm, with 46 acres of cropland. The average farm, as defined in the census, in the piedmont areas of North and South Carolina and Georgia has between 20 and 30 acres of cropland. The one-mule farms are more numerous than the two-mule in most of this area. Such farms need more land much more than the one analyzed.

Improvements on the present acreage that might take the place of buying or renting more land could include use of more green-manure crops and fertilizer, terracing parts of the present cropland, or improving the 22 acres of permanent pasture by liming and fertilizing, terracing, and seeding it, perhaps by seeding in 2 pounds of white dutch clover seed, 10 pounds of lespedeza, and 5 pounds of Dallis grass on the present poor covering of Bermuda-grass sod. They could also include farm woodland improvement. This way of increasing farm incomes has the advantage that it increases rather than decreases the amount of work to be done. A combination of land improvement with farm enlargement may therefore provide employment at reasonable income for more of the population now in the piedmont region than at first appears.

Farm enlargement and land improvement also have opposing effects on the total supply of farm products from an area. If prices of farm products are generally low for a period, because the supplies of foods and fibers are pressing on their markets, as during the 1930's, and employment is open to farm boys and girls in cities, farm enlargement is likely to play the major role in increasing farm incomes in low-income areas. Under opposite conditions, land improvement will be the more important. In the diversification of Southern piedmont farming, the

demand and prices for meats and dairy products are particularly involved. The South, however, is still a deficit area for dairy products, especially in terms of nutritional needs.

HEAD CREEK AND SAND MOUNTAIN FARMS, ALABAMA The contributions that improvements can make are indicated by developments on two "pilot" farms now operated in this general area by the Alabama Experiment Station. The Head Creek Farm is on piedmont terrain adjoining the large piedmont area of Georgia. The feed produced on the farm was increased in three years from 250 bushels of corn and 530 bushels of oats to 300 bushels of corn, 24 tons of oats and wheat (unthreshed grain and straw), 6 tons of grain sorghum (unthreshed), 3 tons of alfalfa and 5 tons of hogged peanuts. In addition, 12 acres of kudzu had not yet come into production. Yields of all crops, including cotton, were increased markedly by using commercial fertilizer liberally and plowing under crotolaria and other green-manure crops. The livestock program of this farm is to include cattle and poultry.[4]

The Sand Mountain Farm is located in the southward projection of the Appalachian area into northeastern Alabama. The soils on the broad smooth mountain tops of this area, on one of which the farm is located, are not naturally fertile, but have a high capacity for the use of fertilizers, like those in the Aroostook area in Maine. As a result, the better parts of this area have been devoted intensively to cotton, and many farms have averaged a bale of cotton per acre in the last decade. The AAA crop controls placed limits on the cotton acreage, and Sand Mountain Farm was established to find a profitable use for the non-quota acres.

The program adopted was one of increasing the yields of corn and other feed crops, as well as of cotton, and feeding the feed crops to hogs. The program for increasing yields involved terracing all the sloping fields with broad-base Nichols terraces, using vetch and crimson clover as green-manure crops, and a liberal use of commercial fertilizers. Sericea is being established on some of the poorer lands. An important part of the hog program is maintaining 10 acres of white clover hog pasture on good moist land, for spring, summer, and early fall grazing, this being rotated with corn every fourth year to keep the native grasses from crowding out the clover. The pigs are not put on full feed till nine or ten months old. In 1943, the cash receipts from about 50 acres devoted to the hog enterprise were $770, a third larger than the receipts from 17.3 acres of cotton. This difference may increase further as the

[4] D. F. King, *Preliminary Report of Operation of a Farm-Size Experiment in the Alabama Piedmont*, Alabama Experiment Station (mimeograph).

methods of feed-crop production are improved. Dairying would return more than hogs. It is apparent, however, that without crop control, the good land of this area will go into cotton as far as other circumstances permit, except as declining prices may call a halt upon this.[5]

SOUTHERN COASTAL PLAIN, BULLOCH COUNTY, GEORGIA Bulloch County, Georgia, chosen to illustrate the nature of the problem of diversifying cash-crop farming on the southern coastal plains, obtained only 11 per cent of its income in 1929 from livestock and livestock products, including poultry. Thomas County, listed in Table 31, obtained 16 per cent, it will be remembered. Tobacco is grown in combination with cotton on a majority of the farms, and peanuts as well on some of them. Still, 71 per cent of the farms were classified as cotton farms in 1929, and only 10 per cent as crop-specialty. "Corn, peanuts, and summer legumes — velvet beans, cowpeas, and soybeans — are the principal feed crops, though on some farms small grains, millet, lespedeza, and other crops constitute important sources of feed. Except for corn and enough hay for workstock, most feed crops are harvested by livestock. Most of the corn is interplanted with peanuts (mainly runner varieties) and velvet beans, cowpeas, or soybeans, which are grazed by hogs and cattle after the corn is harvested. Peanuts are commonly planted in rows, between rows of corn spaced seven feet apart and the other legumes planted in the rows with corn. On many farms these legumes interplanted with corn constitute the only farm-raised feed supply available for hogs and cattle. With these crops, the grazing period usually extends from September 1 through January (Chart 49). A few farmers raise other crops that help lengthen the grazing period. For example, oats can be grazed from December 20 to June 10, lespedeza from May 1 to September 30, and millet from May 15 to August 20. Cowpeas are grown on some farms for grazing in July and August, and Spanish peanuts and early-maturing hybrid corn for late summer and early fall grazing."[6]

This county, in contrast with Greene County, expanded its agriculture in the 1930–1940 decade. In spite of a decrease of a half in the cotton acreage, the total cropland increased 6,000 acres. Tobacco increased greatly percentage-wise, but in acres only from 2,600 to 4,900. The feed crops increased greatly, and livestock with them. Peanuts increased 42,000 acres; velvet beans and cowpeas, 32,000 acres; and corn, 27,000

[5] R. C. Christopher and Kenneth B. Roy, *Cotton-Hog Farming on the Sand Mountain*, Alabama Circular 91, 1945.

[6] W. E. Hendrix, W. T. Fullilove, and C. R. Sayre, *Organizing and Operating Bulloch County Farms to Meet War Needs*, Georgia Bull. 227, 1943, pp. 15–16.

acres. The aggregate increase in dairy cows and hogs was over a half. The wartime changes were in the same general direction except that peanuts took over some of the feed-crop acreage. In Bulloch County we therefore have a county which has already made considerable progress toward substituting livestock for cash-crop production.

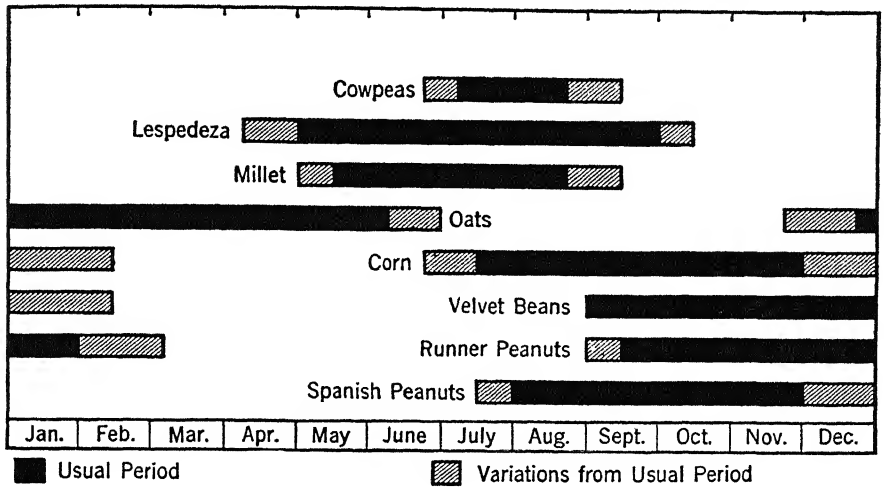

CHART 49. Usual grazing period for the major grazing crops in Bulloch County, Georgia. (Adapted from Figure 2, Georgia Bull. 227, by permission of the Georgia Experiment Station.)

The farm selected for analysis here is a medium-size cotton-tobacco farm with 55 acres of cropland, 12 acres in cotton, 2 acres in tobacco, 30 acres in corn, 3 acres idle, and 6 acres in peanuts, oats and vetch, millet and cowpeas for hay or grazing.[7] Its livestock consisted of 3 milk cows, 3 sows, and 30 chickens. Its total crop receipts in 1940 were $338 from cotton and $225 from tobacco, and its livestock receipts were $61 from cattle, $161 from hogs and $28 from poultry. Against this total of $813 were cash outlays of $320, of which $143 was for fertilizer. No labor was hired. The net cash income was $493, excluding A A A payments of $127.

Three alternative organizations proposed by the group that studied this farm call for increasing the number of milk cows from 3 to 5, and the first also calls for increasing the number of sows from 3 to 4. Thus the shift is towards livestock. In all the plans, the feed is increased more than the number of head of livestock, and likewise the livestock receipts. In the first plan, which is the one that promised best at 1940

[7] This analysis is based on Georgia Bull. 227.

prices, 10 acres more of oats and vetch are grazed; also 5 acres more of cowpeas after oats, and 2 acres of millet. In addition, 12 acres of oats and vetch are plowed under for green manure. Corn is reduced 3 acres, and peanuts for grazing also 3 acres. The cotton acreage is unchanged, but yields are increased. The land is thus much more fully used, but used in such a way as to reduce erosion and add to its humus supply. The income from hogs is increased $348, and from cattle, $193. Cash outlays are increased $145, for fertilizer and seeds mainly, and the cash farm income by $450. The amount of labor is increased, but mostly at slack times in the year.

One of the other two plans replaces feed crops by 9 acres of peanuts for sale as a cash crop, and leaves the hog enterprise at 3 sows. At 1942 wartime prices for peanuts, this plan promised to pay the best, but not at 1940 prices. The third plan goes further and also replaces 3 acres of cotton with peanuts. This was the least profitable of the three plans at both price levels.

COTTON-PEANUT-HOG FARM, HENRY COUNTY, ALABAMA A medium-size farm of 58 acres of cropland, plus 32 acres of other land, in this county on the coastal plain of extreme southeastern Alabama,[8] before the war was growing 14 acres of cotton, 20 acres of corn, and 13 acres of harvested peanuts, and keeping 3 sows. Its other feed crops were 5 acres of hogged-off peanuts, 15 acres of double-cropped velvet beans, and an acre of cowpeas. In 1942, it was harvesting 20 acres of peanuts, hogging off only 2 acres, and keeping 2 sows. Analysis of five alternative organizations, with the cotton acreage varying from 6 to 9 to 14, the corn from 14 to 19, with oats double-cropped in some combinations, the harvested peanuts from 13 to 20 to 27 to 35, and the number of sows from 2 to 3 to 5, showed that at prospective 1943 prices the plan with 3 cows, 35 acres of harvested peanuts, 6 acres of cotton, 14 acres of corn, and 7 acres of oats, produced about $280 more net income than the plan followed in 1942. The plan with 14 acres of harvested peanuts and 5 sows returned only $30 more than the 1942 plan. With cotton at 10 cents, peanuts at 3 cents, and hogs at $7, as before the war, however, the combination with the 5 sows brought in a little more cash.

In this area, it is apparent, peanuts compete on more nearly even terms with forage crops than is true in Bulloch County. Labor distribution is improved on such farms by shifting land to winter and summer legumes and winter oats. Cotton, corn, and peanuts are all planted in

[8] These data are from an unpublished study made by B. T. Lanham and W. F. Lagrone for the Alabama Experiment Station and the Bureau of Agricultural Economics.

the first half of April, and cultivated mainly in May and June. They also overlap at harvest time, although cotton picking begins two weeks earlier than the plowing and picking of the peanuts, and a month earlier than the corn pulling.[9]

THE BROWN LOAM AREA, MISSISSIPPI The major circumstance in this area [10] which conduces to diversification is the extreme erosiveness of its loessal soils. Much of the land is so badly dissected already that it can be used only for woodland and pasture. This area lies in a belt one or two counties wide stretching from Tennessee south to the Gulf, next the Mississippi River except that the wide Yazoo Delta area lies between it and the River in Mississippi (See Chart in Chapter XXXVII). It has two-mule medium-size farms like those analyzed in the first three areas, but three fourths of its farms are one-mule farms. A typical one-mule farm at present contains 75 acres, of which not more than 20 is cropland, 12 acres is open pasture, and the rest is woodland or wooded pasture. Such a farm grows 4 or 5 acres of cotton, 8 or 10 acres of corn, and 4 or 5 acres of annual hay crops and of summer legumes to be turned under, and usually has a few acres idle. It keeps one cow and 20 chickens, and fattens 3 hogs for family consumption. Its crop receipts in 1941 were $200, its livestock receipts $50, and its cash outlays $80.

The farms in this area that were closely analyzed are in four counties at its southern end. The principal change in organization proposed for a one-mule farm is the clearing of some 6 or 8 acres of woodland and establishing pasture on it and growing several acres more of hay crops and oats. Good pastures in this area provide almost year-round feed. This additional feed will support 7 beef cows or 6 milk cows. The beef calves are usually sold as weanlings. Changing to the beef-cattle combination, such a farm will increase its net cash income by a half; changing to the dairy combination, by 90 per cent. The additional investment for the first would be $200 at 1941 prices; for the second, $350.

The proposals for the two-mule farm exactly parallel the foregoing. They would raise the net cash incomes of such farms from $295 to $358 and $546 respectively.

Still more woodland could be converted to pasture on these farms. The survey showed that most of them had considerable woodland that would make good open pasture if cleared and improved. The acreage

[9] Ben T. Lanham, Jr., and William F. Lagrone, *Labor Requirements for Field Crops in the Southeastern Coastal Plains Farming Area of Alabama*, Alabama Special Report, 1942 (mimeograph).

[10] This discussion is based on Mississippi Bull. 384, *Organization and Operation of Farms with Suggested Adjustments in the Brown Loam Area, Mississippi*, by W. G. O'Leary, 1943.

of cotton could even be increased if the A A A quotas were lifted and the market would absorb the cotton. There would be an abundance of labor available for these changes on the one-mule farms. Chart 50 shows that there is also enough for the proposed adjustments on the two-mule farm. The one-mule farms need, it is apparent, a combination of enlargement and improvement, so that the livestock enterprises can be expanded still further. Improvement alone would almost suffice for the two-mule farms.

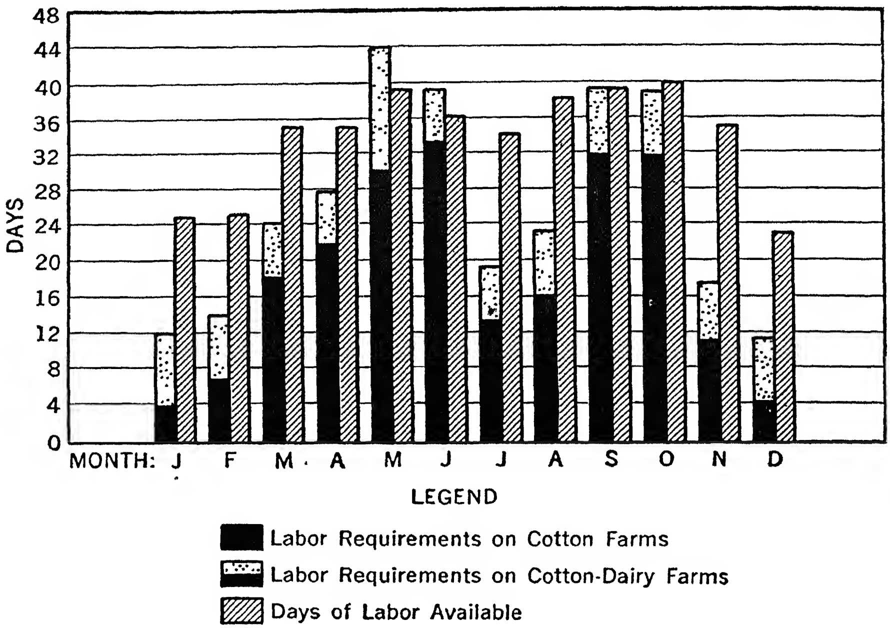

CHART 50. Monthly labor requirements as related to available man-equivalent days of work for resident labor forces, on two-mule cotton and cotton-dairy farms. Brown Loam Area, 1941. (Reproduced with permission of the Mississippi Agricultural Experiment Station.)

THE BLACK BELT OF ALABAMA AND MISSISSIPPI This is a crescent-shaped area[11] about one county wide swinging around from south central Alabama well into northeastern Mississippi, whose characteristic soil type is of the same Houston soil series as that found in the Black Prairie of Texas (See Chart 31 in Chapter VIII). However, it was much thinner to begin with, none of it being Houston Black Clay,

[11] This discussion is based largely on a study by Philip Jones, *Readjustments in the Cotton Economy of the Southeast*, and Mississippi Bull. 404, *Organization and Operation of Farms in the Black Prairie Area, Mississippi*, by W. G. O'Leary, 1944.

and it has been cotton-cropped longer, has suffered much sheet erosion, and the marl or chalk is now near enough to the surface to make much of the soil gray rather than black, and some of it almost white. The heavy soils delay the cotton planting and make the boll weevil harder to control, and much of the land has been so nearly taken over by Johnson grass and Bermuda grass that row crops are difficult to handle. In spite of these circumstances, cotton persists on most of the farms. Cotton yields per acre are low and uncertain, but they increased 59 per cent from 1928–1932 to 1941–1943 while acreage was declining only a half. One hears much about the expansion of livestock farming in the Black Belt, but the data show that this is mainly on a small number of the larger farms that have taken over the stretches of land that have deteriorated most. A large fraction of the farms are operated by Negro croppers, whose average leasehold in 1940 was only 23 acres. Three fourths of these croppers produce less than two bales of cotton a year. Less than half of these small farms were using commercial fertilizer before the war.

Diversifying farming in the Black Belt is obviously faced with severe difficulties. More families than in the other areas which we have studied, except in parts of the Brown Loam area, must find employment elsewhere before the farms can be enlarged to the extent needed to grow feed and forage for livestock. Opportunities for expanding the output by land improvements are sharply limited. Corn yields average around 15 bushels, and peanuts cannot be grown at all. On the other hand, the heavy soils favor grasses and certain legumes. The experiment stations have shown that pastures can be developed that will support one cow to the acre for ten months of the year, using such species as Dallis grass, lespedeza, black medic, and white clover to blend with the Bermuda grass.

However, on the farms surveyed by O'Leary in 1942, the average yield of Johnson grass was 0.8 ton per acre; and the cows on farms with commercial dairy enterprises averaged only 2,760 pounds of 4.5 per cent milk. This points to the human difficulty of getting croppers who have never grown anything but cotton and corn with one mule on a 23-acre farm to learn how to feed and care for dairy cows or cattle and to manage improved pastures. For a family that has learned how to do this, O'Leary proposes a farm of around 80 acres, of which half is in crops, 13 acres being cotton, and with 8 cows, which will keep the family well employed over the year and return a net cash income of $700 to $800 at 1942 prices; or a cotton-beef cattle farm of 100 acres that will yield $650.

If the history of land-use adjustments in this area follows a common pattern, family farms of this description will develop slowly, and in the meantime some major change may impinge on the region — perhaps the mechanization of cotton production and declining prices, perhaps the competition of industry for labor and higher wages, perhaps nothing more than a continuation of sheet erosion — which will cause large acreages in the Black Belt no longer to be planted to cotton; and this land will then find itself absorbed in relatively large cattle farms. This movement has in fact already begun. The O'Leary survey, which was confined to Mississippi, included five such farms averaging 1,140 acres, on which an average of 20 beef cows were being fed and 175 steers were being fattened. Lowndes County, included in Table 31, which lies toward the southern end of the Belt, reported eleven stock-ranches as early as 1929.

WESTERN CROSS TIMBERS, TEXAS This area of sandy soils, so named by the early settlers because it was the second narrow belt of timberland which they had to cross in moving westward, as recently as 1920 depended almost wholly upon cotton. How rapid has been its shift out of cotton since may be judged by the fact that in Erath County in the center of it, the cotton acreage declined from 77,000 to 15,000 between 1929 and 1939. The main reason for this is that the soils have been getting poorer and poorer from cropping, with the result that at the low prices prevailing in the 1930's the families could not make a living growing cotton. The increasing cost of fighting the boll weevil has been a contributing factor. The history of this area serves as somewhat of an augur of the future for some other areas when low prices and rising labor costs strike them.

The major replacement has been peanuts, in those parts of the area that are suited to peanuts. In a few small sections, watermelons and peaches are being grown. The general over-all shift is toward pasture, hay, dairying, and poultry, and an accompanying enlargement of the farms. The readjustments in land use called for are a combination of pasture improvement, more annual grazing and hay crops, plowing under of winter legumes, and growing cotton only on the best fields and enlarging these fields so that the operations can all be mechanized. The acre costs of growing cotton can be very low on such lands. Commercial fertilizers tend to be wasted on sandy soils unless very carefully used. In dry years, they are not utilized by the plants; in wet years, they are leached away before they do much good. The livestock adjustment most needed is better feeding of better dairy cows.

EASTERN OKLAHOMA, OKMULGEE COUNTY The cotton farms of east central Oklahoma, north of the self-sufficing Ozark Plateau region, are like those we have been discussing except that, like the cotton farms of Texas, they tend to replace corn to some extent with grain sorghum, and they have somewhat more livestock. In 1929 in this area, 60 per cent of the farms were cotton farms and 11 per cent general farms. The value of farm products was divided 40 per cent cotton, 16 per cent livestock, and 16 per cent livestock products. In Okmulgee County, which represents this area well, the farms averaged only 90 acres in 1929 and their total value of products was only $1,040. The cotton farms averaged only 1.4 milk cows and 2.1 other cattle, and 40 chickens. The general farms, however, averaged 3.5 milk cows and 5.9 other cattle, and had products worth $1,200. Between 1929 and 1939, the total acreage in crops fell off 24,000 or 35 per cent, but the cotton acreage was reduced 27,000 and the corn acreage 15,000. The only large increase was of 12,000 in oats acreage. The average size of farm rose to 114 acres by 1939. With no restrictions on the acreage of cotton, plenty of cheap labor, and the price and wage combination prevailing just before the war, the acreages in cotton will tend to expand on such farms. If labor becomes relatively scarcer, the shift will be toward either mechanization on larger fields or more livestock.

COTTON-LIVESTOCK FARMING

The cotton and livestock combinations in the parts of Texas [12] west of the Western Cross Timbers area and the Black Prairie, and even including the Grand Prairie area lying east of the Western Cross Timbers area, have generally come to this combination by a different route than the areas which we have thus far considered in this chapter. They were originally ranching areas and shifted to cotton, and at the same time to grain sorghums, when it became evident that the rainfall was sufficient to grow crops of cotton and grain sorghum in most years. The Low Rolling Plains area made the shift mostly from 1890 to 1910. The annual rainfall in the area ranges from 20 inches on the west to 27 inches on the east. The High Plains area, with an average rainfall of 18 to 20 inches, shifted to cotton only in the 1920's. Coupled with the low rainfall is a high rate of evaporation and a good deal of soil blowing on bare fields. The rainfall is also highly irregular, as is common

[12] This discussion is based largely on Texas Bulletins 544, 617, 652, and Oklahoma 1940 *Annual Farm Business Reports* on 14 farms in Oklahoma Area VI in which Custer County is included.

in regions of this kind. Thus, the Rolling Plains area had drouths in 1917 and 1918, as a result of which nearly 30 per cent of its cropland was shifted to small grain in 1919. In 1933 and 1934, the rainfall averaged 9 to 15 inches at the six weather stations in the High Plains area.

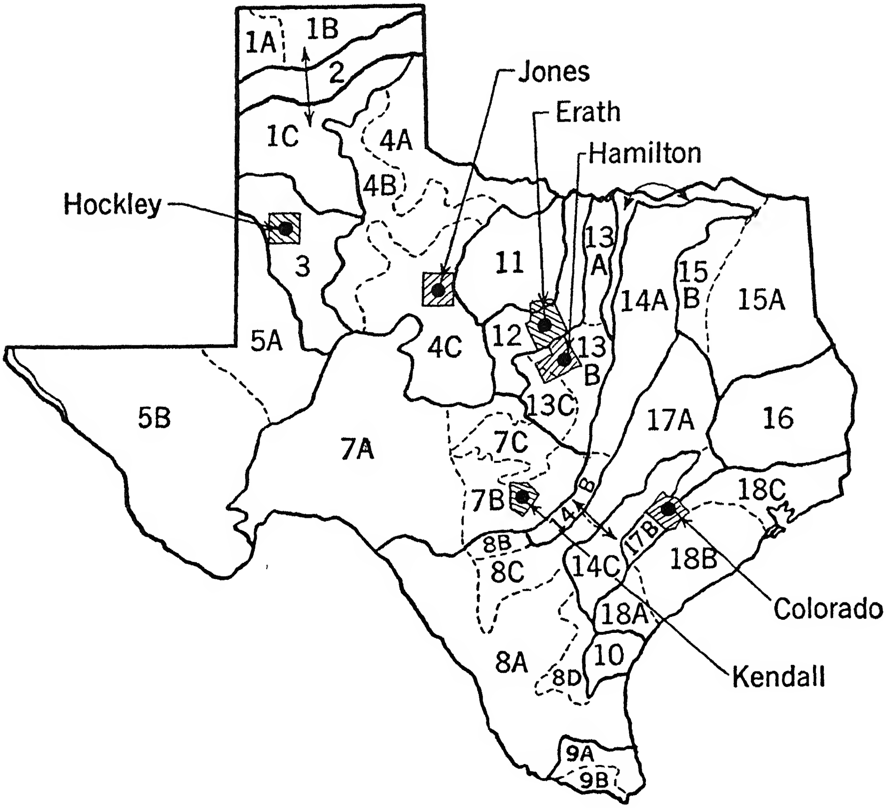

CHART 51. Type-of-farming areas of Texas as drawn by the Texas Agricultural Experiment Station, with location of the six representative counties of Tables 31 and 32. (Reproduced from Texas Bull. 544, by permission of the Texas Agricultural Experiment Station.)

These three and the other cotton-livestock areas of Texas can be located on Chart 51, which presents the type-of-farming area map which has been developed by the Texas Agricultural Experiment Station. It differs from that of the 1930 census survey chiefly in that it shows somewhat more detail. Table 32 presents data for four areas in Texas, and one in western Oklahoma next to the Texas line, and for one representative county in each area. The other areas combining cotton and livestock are 7b on the eastern fringe of the Edwards Plateau, which

has more rainfall than the Plateau itself, represented by Kendall County; Area 11, the North Central Grazing area; Area 1c, which is included in the High Plains area in the census map; all of the Rio Grande Valley and Plains areas except 8a and 9b; and Areas 16, 17, and 18, all parts of which have more or less cattle grazing and most of which grow some cotton too. The Southern Texas areas grow vegetables as well as cotton and cattle and the Grand Prairie grows some small grain.

The farms in the five counties in Table 32 range in size from 205 in Custer County to 560 acres in Kendall County, depending largely upon the percentage of land in crops and cotton. The acreage of cotton per farm varies from 1.2 in Kendall County to 87 in Jones County. In Hockley County, the former range lands have been cut up into farms now over half devoted to crops, and in 1929, over a fourth to cotton. In Area 7b, however, 84 per cent of the land was still in pasture in 1929, and in the Low Rolling Plains area, 61 per cent of it. The North Central Grazing area has as little cropland and cotton as Area 7b. The farms in Throckmorton County in that area averaged 760 acres in 1929. Comparatively few cattle are kept on these farms, however, and except in 7b, much more of the income is from cotton than from livestock. In most of western Texas, 15 or more acres of native pasture are needed per cow. The grass is thin, and browse on mesquite and forbs may be more important than the grass. The figure for the High Plains area is 20 acres. Grain sorghum yields a third more grain per acre than corn in most of these areas, but even then the yields are low.

In the period of expansion, more and more of the native grass sod was broken. Once broken, the land returns to grass very slowly. If cotton is not grown, the land must be planted to sorghum, or to sudan grass for annual grazing, or left idle. The crop restrictions of the 1930's forced developments in all these directions. Cotton acreages declined a half in Jones County, a third in Hamilton, and three fourths in Custer County, and Kendall County practically quit growing cotton. Sorghum acreages doubled or more in Hockley, Kendall, and Hamilton Counties, and increased a third in Jones County. In Custer County, Oklahoma, wheat, oats, and barley took up the acreage released by cotton. Hockley County apparently was not held back by the crop restrictions, for its cotton acreage increased from 95,000 to 106,000 in 1930–1940. The number of farms, however, increased a fifth at the same time. The process of breaking farms out of the range was apparently still under way. Farms at the same time were increasing in size from 258 to 332 acres. They increased in size from 210 to 322 acres in Jones County, and the number of farms declined a fifth in keeping with this.

TABLE 32. SOUTHWEST COTTON-LIVESTOCK AREAS AND FARMS IN FIVE REPRESENTATIVE COUNTIES

	High Plains Area	*Low Rolling Plains Area*	*Edwards Plateau Area*	*Grand Prairie Area*	*Western Oklahoma-Texas*
Type number of area	215	216b	219b	251b	211
Percentage of farm land in:					
Crops [a]	54	20	13	38	51
Pasture	52	61	83	61	59
Corn	1	1	2	5	5
Cotton	27	13	5	14	17
Sorghum	8	7	1	2	5
Wheat	2	1	—	2	5
Percentage of farms:					
General	5	2	10	16	23
Cash-grain	6	2		10	5
Cotton	74	84	55	59	51
Animal-specialty	—		3	3	7
Stock-ranch	2	4	23	3	0
Percentage of income from:					
Cotton	57	63	32	49	47
Livestock	12	23	52	20	22
Livestock products	7	3	2	6	5
Family living	10	8	8	13	14
County	Hockley Texas	Jones Texas	Kendall Texas	Hamilton Texas	Custer Oklahoma
Average farm:					
Total acres	258	210	560	232	205
Value of farm	$9,867	$10,480	$11,760	$7,300	$8,000
Value of products	$2,260	$1,275	$1,750	$1,520	$2,280
Value of equipment	$594	$528	$590	$360	$750
Acres of crops	130	118	49	83	114
Acres of cotton	71	87	1.2	32	29
General farms:					
Value of product	$1,250	$1,032		$1,500	$2,080
Number of milk cows	3.8	3.1		2.3	6.0
Number of other cattle	4.2	3.1		7.2	9.7
Number of sows or gilts	.2	.4		0.2	0.6
Cotton farms:					
Value of product	$2,340	$1,242		$1,450	$2,030
Number of milk cows	2.5	1.8		3.1	3.4
Number of other cattle	3.5	2.2		6.0	5.1
Number of sows or gilts	.2	0.8		0.1	0.2

[a] Some of the land is double-cropped, or used both for crops and for pasture.

If crop restrictions are removed, and cotton prices decline to competitive levels in the years just ahead, most of the cotton-livestock areas of western Texas will grow more cotton than in 1933–1940. Although the yields are relatively low — 150 to 200 pounds in the different areas — mechanization has so reduced the labor inputs that these areas can compete successfully with those producing a bale or more per acre. Cotton is not thinned very much in these areas. Weeds are easily controlled and the boll weevil causes little or no damage in most years. Two-row and four-row motorized equipment has reduced the preharvest labor inputs to 4 to 6 hours per acre in the High Plains Area. The hand-snapping practiced in these areas has reduced the labor of picking about a half, and the mechanical strippers apparently working successfully harvest as much cotton as fifteen men snapping by hand. A recent report of the Texas Agricultural Experiment Station indicates that the mechanical strippers reduce costs 55 per cent under hand-snapping, assuming that all the labor is hired for both.[13] Also, combines have been developed for harvesting grain sorghum. With these new types of equipment, one man, with extra labor for hoeing and harvesting, can take care of 200 to 450 acres of cropland.

Under these assumptions, the livestock enterprises on these farms will tend to be limited in the western Texas areas to the number of cattle that can be kept on land unfit for cropping. Sorghum crops, both the grain and forage types, but especially the former, will be rotated with cotton, partly as a means of keeping up the humus content of the soil. Green-manure crops plowed under make the soil powdery and increase wind erosion. The decaying sorghum crop residues left in the fields not only replenish the humus, but they check wind erosion. The amount of cotton that a family can handle has limited the cotton acreage in the past. It will not do so as much with the new equipment. If labor does limit the acreage, it will be because of difficulties in obtaining enough migrant labor at the hoeing and harvest periods, for even with the new methods, these periods will require considerable extra labor. No doubt the uncertainties of rainfall will continue to check the expansion of the cotton acreages. In stretches of dry years, more of the land will be devoted to small grain and forage crops.

Wind and water erosion have been serious problems in the past. Conserving the water is as important as checking the erosion. The summer rains come in rather heavy downpours. Much of the cotton is now planted on the contour, and some of it is even terraced. Tests show that terracing in the Rolling Plains area will reduce the runoff by 70 per

[13] Troy Mullins, *Harvesting Cotton in the High Plains Area of Texas*, Progress Report 952, 1945.

cent, and contouring by 40 per cent. Terracing interferes, however, with the use of large four-row equipment. Weed grasses, like stink grass, that are spreading over the plains and occupying the land after the cotton harvest, are doing much to check wind erosion.

The problems of the Grand Prairie area differ much from those of the Plains areas. The division of land between uses is largely determined here by the land itself, which varies greatly, from the deep alluvial soils of the bottom lands to the shallow drouthy soils of the rolling and broken uplands. The first are farmed much like the Black Prairie area east of it. The better uplands are used mostly for small grain, more largely for oats than wheat except at the northern end. The alternatives in this area are mainly different combinations of small grains and different systems of beef-cattle management.

The western Oklahoma area differs from the area discussed in Chapter X on "Diversified-Crop Farms" only in that some livestock is combined with the small grain and cotton. In the Oklahoma part of this area, more of the land was in wheat than in cotton in 1929, and in the succeeding ten years, the wheat acreage fell off three fourths. The barley and oats acreage decreased also. The corn and sorghum acreage declined from 93,000 to 35,000 in Custer County in these years. The drouths in these areas had much to do with these shifts. It was in this kind of territory that the Joads of John Steinbeck's *The Grapes of Wrath* were "tractored off" the land.[14] Cattle numbers remained about the same. The rainfall will strongly influence the proportions of cotton and small grain in the future; also developments in the mechanization of cotton growing. In the long run, considerable of the lands now in crops may need to return to range.

FURTHER READING

* C. A. Bonnen and B. H. Thibodeaux, *A Description of the Agriculture and Type-of-Farming Areas in Texas*, Texas Bull. 544, 1937.

P. H. Czarowitz and C. A. Bonnen, *Information Basic to Farm Adjustments in the Rolling Plains Area of Texas*, Texas Bull. 617, 1942.

A. C. Magee, C. A. Bonnen, and B. H. Thibodeaux, *Information Basic to Farm Adjustments in the High Plains Cotton Area of Texas*, Texas Bull. 652, 1944.

M. C. Rochester and Oscar Steanson, *Farm Adjustments in Saluda County, South Carolina*, South Carolina Bull. 315, 1938.

* W. K. McPherson, *A General Appraisal of the Livestock Industry in the Southeastern States*, Alabama Bull. 257, 1942.

[14] The actual Joad family came from the Ozark Mountain area of eastern Oklahoma and had the habits and traditions of that area. It was not a typical "Dust Bowl" family.

* E. L. Langsford, *Changes in Cotton Production in War and Peace*, U. S. Department of Agriculture, F. M. 45 (mimeograph), 1944.

Agricultural Production, Texas, 1950. Prepared by the Bureau of Agricultural Economics and Texas Agricultural Experiment Station. 1945 (mimeograph).

EXERCISES

1. What fraction of the farms in your home county could be classified as crop-and-livestock, as that term is used here? What are the crop and livestock combinations on these farms, and why do these farms not specialize in one or a few products?
2. Work out a complete farm budget for present typical farms and for various suggested alternatives, in one of the southern areas discussed in this chapter.
3. Discuss some of the difficulties encountered in trying to promote livestock enterprises on Southern cotton farms.

CHAPTER XIV

Crop-and-Livestock Farming — continued

THERE STILL REMAINS TO BE REVIEWED THE MANY SYSTEMS OF CROP-and-livestock farming found in the Great Plains, in the Corn Belt, in the Northeast and in the Far West, and the various interesting combinations of dairying or beef-cattle raising with tobacco, potatoes, sugar beets, beans, and the like, in Kentucky, Tennessee, Virginia, Connecticut, Wisconsin, Michigan, etc. Space will be taken here only to describe these systems of farming and state their outstanding management problems. The principles involved and methods of application have been presented in Chapter XIII and earlier chapters.

GRAIN-LIVESTOCK FARMING IN THE GREAT PLAINS

Anywhere in the vast stretch of territory from the Red River Valley of the Dakotas to the Rocky Mountains and southward to Oklahoma and Texas, one may find sizable areas or pockets of land where the climate, rainfall, soils, water supply, and markets are such as to favor a combination of one or more cash crops — commonly wheat — with running cattle on the range, or with dairying, or with a combination of the two in dual-purpose herds; or the growing of corn, oats, barley, alfalfa, and other feed crops, and selling part of these for cash and feeding part of these out. Interspersed with these areas will be others which are scarcely able to produce winter feed enough for their range cattle; and others, like western Kansas, where with average rainfall and normal prices the more acres that can be used for cash crops, the larger the income of the area. Other things being the same, as the rainfall declines westward, more of the land will support ranching only, but topography and soil are highly important locally. Nearly everywhere, some of the land is so rough that grazing is its only feasible use. Often farms with a preponderance of rough land are interspersed in the same area with those with a preponderance of arable land.

Much of the three northern states in this region, the Dakotas and Montana, is too far north or west to grow corn. The livestock is therefore mostly beef cattle, which are usually not fattened on grain before being marketed. The rainfall in this vast territory ranges from 25 inches in western Minnesota to 16 inches in western North Dakota, to 12 inches or less in some parts of Montana. The relatively cool temperatures, however, and the distribution of the rainfall, make this limited rainfall unusually effective. As already indicated, the major reason that most of the farms in some sections of this region are not straight livestock farms is that grain yields a larger return per acre than pasture. If any land will grow wheat at all, it is likely to be used for wheat. Sections of eastern Montana and western North Dakota which had only one or two paying wheat crops in the ten years after 1930 still kept on trying to grow wheat, albeit with the aid of seed loans and A A A payments which made it possible for them to stay on their farms. These farms combine livestock with crops to some extent because this provides a more assured income year in and year out, but mainly because they have considerable land too rough or drouthy for cropping.

The three southern states, Nebraska, Kansas, and Oklahoma, and eastern South Dakota, are far enough south to grow corn where the rainfall suffices, and to grow winter wheat instead of spring wheat. The easternmost sections grow some oats, and the more western sections a little barley. The livestock here also consists mostly of beef cattle; but a good many hogs are raised in eastern Nebraska and Kansas. The rainfall is around 25 inches on the eastern edge of these states and 15 inches in eastern Colorado. It is a little heavier toward the south, but evaporation is greater.

The grain sorghums that replace corn in the southwestern sections of the Great Plains can also be used to fatten cattle. Feeding trials conducted at the Texas and Nebraska stations show that hegari, Kafir corn, milo, and the other sorghum grains are not as efficient meat producers, pound-for-pound as corn, by a margin of around a fourth, but that enough of them can be fed to put a good finish on beef. The forage types of sorghum and sudan grass make good succulent feeds.[1]

Table 33 enables us to observe the wide differences within this region. The Dakota area grows a little corn. Only two counties away in Minnesota, a third of the cropland was in corn in 1929. To the west in this latitude, less of the land is in crops and more in pasture, and less of the cropland is in barley and oats and more in wheat and flax. Hill County, Montana, was 80 per cent in wheat in 1929. Adams County in central

[1] Texas Bull. 564; Nebraska Bull. 347 and 354.

Nebraska, however, had 40 per cent of its cropland in corn in 1929, and Marion County in central Kansas, 22 per cent of it. In western Oklahoma, grain sorghum replaces corn.

That some of these areas were flourishing in 1930 is evident from the values of the farms and the values of their products. By 1940, however, the situation had greatly changed. Almost this whole region suffered severely from the drouths of the 1930–1940 decade. Chart 52 shows clearly the effect of the drouths in the period from 1933 to 1937 especially. The production of the seven states called the Northern Great Plains fell off a third from the 1927–1930 level. The A A A program undertook to reduce the acreage of wheat, but not very successfully before 1938. In the peak year, 1937, over 70 million acres were seeded. From 1939 to 1941, however, wheat seedings were held at around 62 million acres, and the harvested acreage at considerably less. Then in the period of abundant rainfall after 1940, production in these seven states increased twice as much as that for the country as a whole.

TABLE 33. THE GREAT PLAINS GRAIN-LIVESTOCK AREAS AND FIVE REPRESENTATIVE COUNTIES, 1929

	Triangle Plains Montana	*N. E. S. Dak. and S. E. N. Dak.*	*Nebraska Plains*	*Kansas-Colorado High Plains*	*Wichita Prairies, Kansas*
Type number of area	113	174a	195	190	202a
Percentage of farm land in:					
Crops	34	77	70	34	66
Pasture	61	16	26	64	30
Corn		11	34	8	20
Oats		11	5		4
Barley		12	1	5	
Wheat	19[a]	18	21	8	32
Flax	0	3			
Hay	2	11	5	2	5
Percentage of farms:					
General	5	32	16	20	26
Cash-grain	73	42	63	38	42
Animal-specialty	1	17	15	13	18
Dairy	1	4	1	3	3
Stock-ranch	11	—	—	10	—
Percentage of income from:					
Crops	63	43	39	38	32
Livestock	25	24	40	40	40
Livestock products	3	12	5	8	7
Family living	6	13	10	7	9

TABLE 33. THE GREAT PLAINS GRAIN-LIVESTOCK AREAS AND FIVE REPRESENTATIVE COUNTIES, 1929 (Continued)

	Triangle Plains Montana	*N. E. S. Dak. and S. E. N. Dak.*	*Nebraska Plains*	*Kansas-Colorado High Plains*	*Wichita Prairies, Kansas*
County	Hill Montana	Marshall S. D.	Adams Nebraska	Greeley Kansas	Marion Kansas
Average farm:					
Total acres	906	366	203	667	231
Value of farm	$8,600	$11,896	$16,742	$11,368	$17,400
Value of products	$2,350	$2,666	$2,338	$2,670	$2,690
Value of equipment	$2,030	$1,250	$1,035	$1,187	$1,070
Acres of cropland	270	229	157	277	139
Acres of wheat	217	72	57	140	64
Acres of corn	1	35	64	67	31
General farms:					
Value of product	$1,570	$2,189	$1,714	$1,254	$1,930
Number of milk cows	4	8	5	6	5
Number of other cattle	13	14	7	13	13
Number of sows or gilts	1	5	3	2	1
Animal-specialty farms:					
Value of product	—	$3,578	$3,826	$2,626	$5,840
Number of beef cows	—	7 [b]	5 [b]	11	8
Number of other cattle	—	24	12	27	42
Number of sows or gilts	—	11	8	6	3
Cash-grain farms:					
Value of product	$2,450	$2,897	$2,161	$3,373	$2,000
Number of milk cows	2	6	3	2	4
Number of other cattle	8	12	5	18	10
Number of sows or gilts	1	6	3	1	1

[a] Other cropland in fallow.
[b] Milk cows.

Drouths and crop control together reduced the flax acreage by a half between 1929 and 1939. Hill County, Montana, lost 100,000 acres of wheat in the decade, 18,000 acres of flax, and 11,000 acres of rye; Adams County lost 42,000 acres, all of corn; Morton County in central North Dakota, not shown in the table, lost 94,000 acres of wheat, 22,000 acres of flax, and 7,000 acres of barley. Although Hand County in central South Dakota lost over 160,000 acres of corn, wheat, flax, and oats, part of this was made up by more sorghums, barley, and rye. Marshall County lost 37,000 acres from barley, wheat, and corn. Much alfalfa was killed by the drouths in some of the counties. In western

Kansas and Oklahoma, sorghum replaced a good deal of corn. Many of the counties had 50,000 acres or more of idle land in 1939.

Only in a few of the counties, however, did cattle numbers decline, in spite of the drouths. Numbers of hogs declined in all the areas, but most sharply in South Dakota.

This whole region can be expected to expand its production over the years because it is still relatively new farming territory. Much of the increase after 1920 came from the substitution of tractor power for horses. We shall sense better the management problems of the farms of this region as elsewhere if we provide them with actual farm settings.

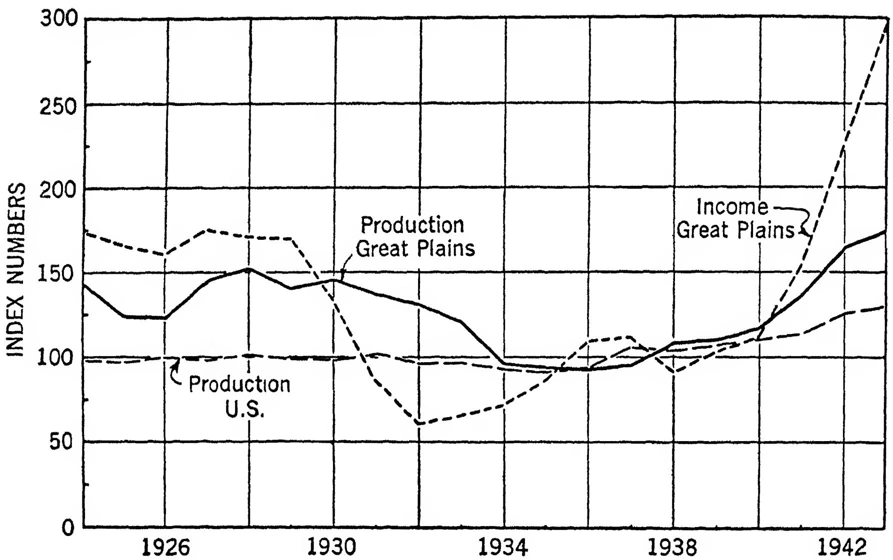

CHART 52. Agricultural production and farm income, Northern Great Plains, 1924–1943. (1935–1939 = 100) (The Northern Great Plains include Kansas, Colorado, and the five states lying north of these.) (Reproduced by permission of the Bureau of Agricultural Economics of the U.S.D.A. from *Trends in Volume of Agricultural Production, Land Utilization and Farm Income, Northern Great Plains, 1924–1943*, by Ralph E. Ward, 1944.)

A HIGHLY DIVERSIFIED TRACTOR-OPERATED NORTH DAKOTA FARM, AREA 174A, SARGENT COUNTY, NORTH DAKOTA This farm, in Sargent County across the state line from Marshall County in the table, is chosen partly because it shows how diversified and involved a crop-and-livestock farm may become on the eastern side of the Great Plains.[2]

[2] The farm analyzed here closely follows farms described in U.S.D.A. Bull. F.M.–19, *The Sargent County Farmer Looks Forward in His Adjustment Problems*, by Lloyd E. Jones, 1941.

This farm, it appears in the following, was growing six different grains and selling most of five of them, and selling eight kinds of livestock or livestock products. The more usual farm in this area would grow four or five grains, and have five livestock sources of income. Sheep and turkeys are raised only on a minor fraction of the farms. Flax is a more usual crop than millet seed. There are four good reasons for this diversity: (1) The farm income is more stable. The yields of only part of the crops are likely to be low in any year, and the livestock will provide part of an income in almost any event. (2) The labor of the farmer and members of his family and the farm equipment are employed fully and rather evenly throughout the year. (3) The different types of land on the farm are more likely to find uses well adapted to them. (4) Probably most important of all, such a farm organization is highly flexible and can be adjusted to the vicissitudes of weather and markets. If the soil moisture seems to be too low in the spring for a crop of wheat, a shift can be made to forage crops to produce feed for the livestock — especially to forage sorghums in the northern plains and to grain sorghums in the southern plains. If the feed supply is low, the calves can run with the cows and be sold early in the fall; or sold as young calves so that more butterfat can be sold. The cattle on the farm are of the dual-purpose Shorthorn breed.

This same flexibility causes one of the major management problems of such a farm. The crop rotation must be rather indefinite. In general, corn is followed by small grain, and this by a second crop of small grain. The legumes remain on the same land more than one year, and are put on new ground when planted. In this way, they "make the rounds" of the crop acreage over a period of years. The small-grain stubble is plowed with a moldboard plow. Last year's cornfields are usually disked rather than plowed before planting. The rotation on the lighter soils in this area is likely to be corn and wheat, with the occasional seeding of legumes on each field. Over a period of years, corn will produce a half larger tonnage of grain than wheat in this area, and on lighter soils the margin in favor of corn is still greater. In some years, wheat outyields corn; but at the other extreme, corn has produced five times as much grain as wheat in a few years. In terms of relative prices and yields in the ten prewar years, wheat outdistanced all the other small grains, and ran almost even with corn except on the lighter soils. Twenty years ago, flax produced more income per acre than wheat, but flax yields have declined since in this area, because of the competition of weeds, disease, and other factors. The prewar structure of relative prices was, of course, distorted by government controls.

FARM ORGANIZATION, 1939

Crops	*Acres*		*Livestock*	*Number*
Wheat	40		Horses	2
Corn	55		Milk cows	10
Oats	40		Calves	6
Barley	30		Heifers	4
Rye	10		Bulls	1
Millet	10		Sows	8
Alfalfa	15		Pigs fattened	38
Total crops		200	Ewes	30
Sweet clover pasture		25	Lambs fattened	20
Native hay		30	Chickens	75
Native pasture		55	Turkeys	8
Farmstead, roads, etc.		10		
Total		320		

Equipment: tractor with accessories, 10-foot pressure grain drill, combine.

Receipts (Crop year 1939–1940)		
Wheat — 512 bu. at 75¢	$384	
Oats — 876 bu. at 25¢	219	
Barley — 301 bu. at 35¢	105	
Rye — 140 bu. at 53¢	74	
Millet — 230 bu. at 35¢	80	
Cows — 2 at $50	100	
Butterfat — 1,450 lbs. at 25¢	362	
Calves — 6 fed to 950 lbs. at 8¢	456	
Sows — 8 weighing 350 lbs. at 5¢	140	
Hogs — 38 weighing 220 lbs. at 7¢	585	
Ewes — 10 weighing 120 lbs. at 3¢	36	
Lambs — 20 weighing 90 lbs. at 8½¢	153	
Wool — 300 lbs. at 20¢	60	
Chickens — 75 at 50¢	38	
Eggs — 320 doz. at 15¢	48	
Turkeys — 79 weighing 15 lbs. at 18¢	213	
Total receipts		$3,053

Expenses (Crop year 1939–1940)		
Feed	$165	
Seed	12	
Baby chicks	12	
Threshing, corn shelling	117	
Trucking	77	
Hired labor	50	
Tractor, including gas and oil	180	
Automobile for farm use	104	
Other repairs	82	
Taxes	200	
Miscellaneous	85	
Total expenses		$1,084

Inventory changes

Depreciation on buildings and equipment	— $220	
Feeds on hand	+ 120	
Total inventory changes		— $100
Net Business Gain		$1,869

he is likely to make some rough calculation as to the relative returns from selling or feeding grain, and when grain prices are low relative to meat or milk prices, to feed more generously than at other times; and vice versa. The most profitable rate of feeding dairy cows at prices prevailing in Sargent County before the war was around 6,800 T D N's. Most of the cows did not receive this much feed.

Several factors affect the kind of feed to be used. On a cost-per-T D N basis, corn, oats, and barley average practically the same in this area, and wheat a half more at prewar prices. Only in occasional years have wheat prices dropped to a livestock-feeding level — never in the recent prewar years when wheat prices were being supported by government loans, export subsidies, and the like. During the war, the feeding of wheat was heavily subsidized. If the price of wheat is allowed to seek its competitive level in the near future, it will be cheap enough to feed, to dairy cows especially, in many parts of the Great Plains. It may even become cheap enough to feed to hogs in some areas, especially as a supplement to corn where both grains can be grown.[4]

Many farms in the eastern Great Plains, like the Sargent County farm, now have small flocks of sheep. They utilize the available grain and salvage the low-grade roughage effectively. Poultry production is expanding in this region.

Farther west in the Montana Triangle area, and in the areas lying between, wheat has a clearer advantage over other grains.[5] Definite crop rotations may disappear, wheat being grown continuously or in varying fallow arrangements. Flax, barley, oats, and corn may be grown on certain lands or in favorable moisture years. As the crop production becomes more specialized in wheat, the livestock enterprises become less dependent on farm grain production and more on pasture. On the eastern border of the Great Plains, the pastures resemble those of the western Corn Belt. To the west, they take on the character of good range pastures. As such, they have their special problems of management for sustained maximum production, which are discussed later in the chapters on Cattle and Sheep Ranching. Forage production on these native pastures is limited chiefly by precipitation. If an effort is made to graze them too severely, the vegetative cover, particularly the more palatable species, is eaten so closely that many plants are killed. The number of livestock and the season of use must be regulated to the forage production of an average season.

[4] Farmers more than twenty-five miles from an elevator or railroad may find that hauling costs make the feeding of grain advantageous.

[5] See *Montana Bull. 367, *Farm Adjustments in Montana, Area VI,* by Neil W. Johnson.

NEBRASKA LIVESTOCK-GRAIN FARMS Two large areas in Nebraska, together occupying half the state, should not be classified as livestock-grain areas, one of them being the feed-livestock area in the northeast discussed in Chapters XI–XII, and the other the excellent range area of the Sandhills. The rest of Nebraska combines cash crops and livestock in one proportion or another. Southeastern Nebraska, where Adams County is located, grows the most corn and feeds the most hogs, but also sells much grain. The western areas sell much wheat. In 1937, L. F. Garey of the University of Nebraska published a study in which he analyzed the effects of shifting the agriculture of these areas over to a more soil-conserving basis, in keeping with the objectives of the A A A program.[6] This meant mostly less corn and wheat, and more alfalfa and other tame hay, and sweet clover and winter rye for pasture. The shifts he considered were very small in the central Nebraska areas, around 5 per cent, but larger in the wheat areas. He also considered the alternative of feeding all the feed grain and hay produced to hogs or beef cattle or milk cows instead of selling part of it for cash. His analyses indicate first, that at the prices then prevailing, these small changes in land use could be made without reducing the farm income significantly even in the short run, except in the western cash-wheat areas; second, that simply feeding to hogs all the corn and barley produced at present would increase the net cash income by 10 to 12 per cent; and third, that when the livestock systems were adapted to the changes in the crops and pasture, the proposed soil-conserving systems promised larger returns than the present systems, by percentages ranging from 6 to 26, again except in the cash-wheat areas.

CENTRAL KANSAS LIVESTOCK-WHEAT FARMS Kansas Bulletin 312 presents budgets for three or four alternative farm organizations for each of three sizes of farms, 160, 320, and 480 acres, in the Wichita Prairie area of central Kansas.[7] Wheat is the major crop in all these organizations. The livestock alternatives analyzed include producing whole milk for sale in the Wichita market, producing butterfat and feeding the skim milk to hogs, keeping a flock of ewes and selling lambs, and buying and fattening feeder calves or steers, or a few combinations of these four. The feed crops are adjusted to fit the livestock enterprise, but they include no corn. The other grains are oats, barley, and sorghum. Soybeans are used for silage. The prices used were the 1924–1938 averages.

[6] L. F. Garey, *Systems of Farming and Possible Alternatives in Nebraska*, Nebraska Bull. 309, 1937.

[7] R. J. Doll, *Planning the Farm Business in South Central Kansas*, Kansas Bull 312, 1943.

The livestock organization which provided the largest net cash income on the 320-acre farm analyzed called for purchasing 50 feeder steers in the fall, fattening 30 of these in the winter on silage, alfalfa, and some grain, and selling them in the spring, and practicing deferred feeding on the remaining 20, that is, running them on pasture till August and then fattening them. This system provides a good utilization of the labor force over the year. The organizations with milk cows promise the lowest returns in this area, at the prices used, unless the milk is sold as market milk, in which case they rank second on the 320-acre farm, and an easy first on the 160-acre farm. The sheep organizations promise about as well as the cattle organizations. The lambs are dropped not later than March 1 and sold by June 15. This enterprise, therefore, supplements wheat very well. Of the three cattle-feeding systems considered for the 480-acre farm, with crops to fit, the one that promised best called for buying steer calves in the fall and feeding them under the deferred systems.

THE GENERAL FARMS OF THE GREAT PLAINS · A majority of the Great Plains farms which we have been discussing are classified as either cash-grain or animal-specialty farms because their income from grain or meat animals adds up to 40 per cent of the total. In the eastern part of the Great Plains are many smaller farms, often with only 80 acres, or with 120 or 160 acres, which can produce a sufficient income for their families only if they are more intensively farmed and their labor is more fully utilized. These farms are likely to sell much less of their grain, to grow more feed crops, to have milk cows rather than beef cattle, and to have relatively large farm flocks of poultry. They are much like the Sargent County farms except that they are smaller and sell less grain. Their markets for butterfat have not been very good over the years, since they must sell it in the form of sour cream and pay shipping charges to centralizer creameries. These farms need to grow more alfalfa than most of them do, and to provide more sweet clover, sudan grass, and other supplementary pastures. The poultry enterprises on these farms have expanded and improved since the practice of buying hatchery chicks became established, and turkey raising became less hazardous. Poultry farming is more important in the southern than northern Great Plains states because the winters are less severe. The by-product damaged kernels and weed seeds of the grain enterprises furnish a considerable part of the poultry feed. Several egg-drying plants were built in this region early in the war. With enough cows to support local processing plants, dairying would be more profitable.

CORN-BELT LIVESTOCK AND CASH-GRAIN FARMING

Between the Corn Belt farms which sell most of their corn, soybeans, and oats or wheat for cash, analyzed in Chapter X, and those which feed most of their crops to beef cattle, dairy cattle, or hogs, analyzed in Chapters XI and XII, are a few hundred thousand farms which do enough of both so as commonly to be classified as general farms because less than 40 per cent of the value of products comes from cash grains or meat animals or dairy products. These are scattered all over the Corn Belt areas shown in Chart 42 in Chapter X and 44 in Chapter XI, but as indicated at the beginning of Chapter XIII, are most numerous from Michigan south along both sides of the Ohio-Indiana boundary and thence westward to Missouri.

These farms acquired their diversified character by a somewhat different historical process than the crop-and-livestock farms of the Southwest and the range states. Although some ranching was carried on along the frontier, it was for a very brief period in the Corn Belt. The settlers began growing wheat and corn and other small grains and selling the wheat and corn for cash, or feeding the corn to hogs and selling it as cured pork, and feeding the coarse grains to cattle and driving these to market. Selling corn for cash has persisted near to cities like Chicago and Peoria where corn is needed for industrial uses, and as a supplement to livestock farming somewhat farther from market. In many situations, more oats or barley are needed in the rotation systems than can be fed to advantage to the kinds of livestock which they keep. Thus, a tractor-powered corn-and-hog farm has little need for the oats as feed which are required in rotation with corn and clovers. Soybeans fit excellently into such a situation, and so they expanded rapidly after 1933, contributing further to a persistence of cash-crop production. Also, wheat fits into the rotation better than oats in the southern half of the Corn Belt, and wheat needs to be lower than usual in price before it pays to feed it to cattle or hogs.

No doubt a further reason for the persistence of the cash-grain selling is that this is a region of highly fertile and level lands that can be cropped year after year provided the rotation includes even a limited amount of close-grown crops and some legumes. If the corn is fed to livestock, especially to cattle, the farming becomes more intensive and the burden of labor is increased. Given sufficient pressure of population on our land, most of this territory will pass into this more intensive use. But many of the farmers have acquired title to large enough farms, out of the gains from farming these fertile lands, or in other ways, so that they

can obtain incomes enough to satisfy them without farming more intensively.[8] On many other farms, the family labor supply is too small to care for all the crops and for all the livestock that could be fed out on the crops. Rather than hire extra labor, many operators prefer to sell a part of their crops. In general, the feed supplies are more than ample to feed at optimum rates all the livestock now kept on such farms. There is a tendency to overfeed on some farms because feed supplies are so large in relation to livestock numbers.

But although the Corn Belt has smoother terrain than the areas to the north, east, and south, it still has more rough or rolling land than is ordinarily supposed. Toward the north, glaciation left the land more choppy and uneven. Also, since grass grows better in cooler climates, more of the land to the north is in hay and pasture, and therefore more dairying is practiced. Toward the south, spring grains do not yield well and less oats as well as hay are grown.

Livestock numbers have in general increased in the last fifteen years on the livestock-and-cash-grain farms in the Corn Belt. The A A A program of increasing forage crop production led to increased cattle numbers to utilize this forage. The shift from horses to tractors both released feed for livestock production or sale and released a part of the time of the operator and his labor force from crop production. During the war, the ceiling prices on corn and hogs favored feeding the corn to hogs rather than selling it for cash. Cattle fattening was also profitable in most years during the war. As a result, livestock production increased sharply on a large number of the farms that had formerly sold a part of their grain for cash. After 1943, the dairy-subsidy payments stimulated dairying. In many cases, the only cash grains sold in recent years have been wheat and soybeans.

If the prices of wheat and soybeans drop relative to those of other farm products, as seems likely presently, many of these farms will shift from these toward more feed grains and this will reduce cash-grain sales still further. There will always be, however, the countering influence that prices of these cash crops do not need to be very high before they add more to farm incomes than oats even after these are fed to livestock. All too commonly, also, the cash-grain farmers are not skillful with livestock. They keep the few head of livestock needed to utilize the forage produced in their crop rotations and perhaps to have something to do in the winter months; but beyond this they do not venture.

Another countering factor in southwest Minnesota and west central

[8] See Arthur Moore's description of McLean County, Illinois, in his *Farmers and the Rest of Us*, Boston, Little, Brown and Company, 1945.

Illinois, and to a lesser extent in other areas, is that the tenant rents his farm on a crop-share basis and feeds only his share of the crops, the landlord's share being sold for cash. Often the buildings and feeding facilities on these rented farms are inadequate for a livestock program which would fully utilize the feed produced.

One of the usual reasons for diversification, namely, to spread risks of crop failure, is not highly important in the Corn Belt. Seldom does the region experience widespread crop failure, and the price hazards are mostly of a kind that diversification will not help. Many Corn Belt farmers would do well to simplify their businesses somewhat by discontinuing their cash-crop wheat, or changing their cattle enterprise wholly to beef or to dairy, and thus be able to concentrate more on two or three lines of effort.

The long trend in the Corn Belt will no doubt be toward more livestock production, if for no other reason than soil maintenance. The Corn Belt farmers are growing more and more legumes, plowing under more and more sweet clover and other green-manure crops, applying more lime and fertilizers, and keeping their land more protected by cover crops. But still they will not stand indefinitely the continuance of a large acreage of crops like corn and soybeans and selling off the land the plant nutrients represented by these. On the smooth lands of this region, the problem is mainly one of maintaining good soil structure by growing grasses and especially deep-rooted legumes periodically, and of maintaining supplies of phosphorus and potash in the soil. On the sloping lands, erosion is the major factor in soil maintenance.

The highly diversified farms of the Corn Belt must have a large investment in buildings and equipment; in buildings, to house the several kinds of livestock kept and store the winter's supply of feed; in equipment, to handle the different crops and feeds. If labor is to be economized, such a farm needs a combine, a corn picker, a feed grinder, a silo filler, and some efficient type of haymaking equipment. No small general farm can afford these. Hence, some important developments are under way to meet this situation, especially an increased amount of custom work.

Several factors have combined to accelerate the trend toward more dairy cows and fewer dual-purpose or beef cows in the Corn Belt — improvement in milking machines, extension of electric power to more farms, educational programs in dairy-cow feeding, cow testing, and culling, and the relatively favorable prices for dairy products since 1921. The shift toward increased dairying has been most pronounced in communities adjacent to fairly large cities with their growing demand for

fluid milk. Livestock-grain farms in Ohio, Indiana, and northwest Illinois have shifted more toward dairying than similar farms in southwest Minnesota and west central Illinois, partly because of increasing outlets for fluid milk at relatively high prices, and partly because the farms are smaller in these areas.

A parallel set of circumstances has led to an increase in poultry production, especially on the smaller general farms. The farm flocks now run from 100 to 250 hens on such farms in many sections of the Corn Belt. Farm record-keepers in Iowa received $175 in gross income for each $100 worth of feed consumed by poultry during the years 1932–1940, compared with $142 return per $100 of feed fed to hogs during the same period.[9]

NORTHWESTERN CORN BELT Let us now consider briefly a few representative livestock-and-cash-grain areas and farms in the Corn Belt. Cottonwood County in the crop-and-livestock farming area of southwestern Minnesota may be taken to exemplify such farming on the northern edge of the Corn Belt. No wheat is grown. The corn acreage about equals that of barley and oats combined. The representative farm studied for this area shifted its barley acreage to flax and soybeans in 1943 because of wartime demands. This farm has four fifths of its land in crops, which means relatively little in pasture. It fattened 110 hogs and 12 sows, and 6 yearling steers raised from a small dual-purpose herd of 8 cows. The cows are milked and the calves hand-fed from the start. This farm keeps 200 hens and buys 500 baby chicks in most years. This particular farm is therefore more nearly a feed-livestock farm than a cash-grain farm. In the area as a whole, 27 per cent of the income was from cash-grain in 1930, but the number of cattle and calves had increased a fifth by 1940.[10]

In Ogle County, in northwestern Illinois, the dairy income is somewhat more important and more of the land is in pasture and hay.

CENTRAL CORN BELT In the central and more southern parts of the Corn Belt, the livestock-grain farms run more toward cash grain. In Piatt County, for example, two thirds of the farm receipts were from cash grains in 1930 — from corn, wheat, and oats in the order named. Part of the corn was fed to hogs, and a few milk cows were kept. By 1940, this county had shifted a third of its corn and two thirds of its oats to soybeans. A representative farm in this area had its cropland

[9] *Summary of Iowa Farm Accounting Records*, 1940 (mimeographed).

[10] George A. Sallee, George A. Pond, and C. W. Crickman, *Farm Organization for Beef Cattle Production in Southwestern Minnesota*, Minnesota Tech. Bull. 138, 1939.

divided in 1943 in the proportions of corn, 10; soybeans, 7; oats, 2; and red clover hay, 2; and its receipts divided 76 per cent crops and 24 per cent livestock, this latter being divided about equally between hogs and dairy cattle.

GENERAL FARMS, OHIO-INDIANA The general farms of this part of the Corn Belt run about 100 acres in size. Their receipts are about equally divided between cash-grain, livestock, and livestock products, corn and oats being sold toward the north, and corn, wheat, and soybeans toward the south. The farms that are not classified as general are most likely to be called animal-specialty. These feed out their corn to hogs mostly. Why these general farms do not feed out all their grains and increase their incomes is not at once clear. Between 1930 and 1940, the farms along the Ohio-Indiana border shifted strongly from oats to soybeans and wheat and reduced their acreage of corn a little, and of hay somewhat more. They increased the number of cows milked by a fourth, and the number of hogs even more. Total crop acres increased in most of the counties. These farms were therefore definitely intensifying their agriculture, but still continuing to mix crop and livestock production.

LIVESTOCK–TOBACCO FARMS

Only a few types of tobacco grown in this country are highly specialized in production, namely, the flue-cured tobaccos of North Carolina-Virginia discussed in Chapter VIII, the shade-grown tobaccos of southern Georgia and northern Florida and of the Connecticut Valley, and some of the field-grown tobaccos of the Connecticut Valley, Maryland, and a few other sections. And only in the South Atlantic states is much tobacco grown in combination with another cash crop. Elsewhere, the combination is with livestock, usually either dairy cows or beef cattle. The main reason for this is that tobacco and livestock supplement each other in the use of the labor and together provide a much fuller utilization of the family labor supply than either does alone. Most of the farms on which tobacco is grown in combination with livestock are relatively small, especially if measured in acres of land suitable for crops, and would have low incomes without the addition of the labor-intensive high-value tobacco crop. The cigar-leaf and some other types of tobacco also need a soil with a high humus content, which is most easily achieved by using barnyard manure.

Space will not allow consideration of all the areas growing the twenty-five officially classified types of tobacco produced in this country.

Chart 53 shows the location of nine type-of-farming areas, according to the census mapping, in which tobacco is listed as the largest single source of income, and eleven in which it is second in importance or less. In the mountain areas of eastern Kentucky and in Tennessee and western North Carolina, and on the Western Highland Rim area of Tennessee, the farms are mostly of a self-sufficing type and tobacco fits in as a main source of cash income, usually along with a few half-grown baby beeves.

In a sample of ten counties selected from these twenty areas, the farms averaged 85 acres, of which 34 acres were in crops and 33 acres in pasture. Corn occupied 14 of the 34 crop acres, and tobacco scarcely 3 acres. These 3 acres nonetheless furnished 30 per cent of the farm income. Livestock provided 19 per cent of it, and livestock products including poultry 14 per cent of it. Farm products consumed by the family ran as high as a third in two of them.

Only 60 per cent of the farms in these ten counties grew any tobacco, however; and these 60 per cent averaged 4.4 acres of tobacco, the range being from 1.3 acres in Washington County, Tennessee, to 14 acres in Hartford County, Connecticut. The one third of the farms that were classified as tobacco farms in 1930, because of obtaining 40 per cent or more of their incomes from this source, averaged only 3 milk cows and 4 other cattle per farm. Table 34 presents further details as to the organization of the farms in six of the ten areas and six selected counties. The farms growing tobacco have lower-than-average receipts in Bourbon and Miami Counties, but larger elsewhere. The range in values of product is wide even within the state of Kentucky.

The acreage of tobacco declined between 1929 and 1939 in all the ten areas except in the mountains and in the Tennessee Valley. It fell off only about a tenth, however, in Blue-Grass areas. The decline in the Wisconsin area was a fourth and in the Miami Valley area a third — consumption of cigars was on the wane in that period. The Pennyroyal area was suffering from a loss of its export market for dark tobacco and was shifting to burley. Its acreage fell off by 45 per cent. The A A A crop controls no doubt augmented this decline by hastening needed readjustments. War demands increased the acreages in areas producing cigarette tobaccos. The accompanying changes in the Kentucky Burley areas were away from corn toward hay and a little more winter wheat, and toward more dairy cows in some areas and more beef cattle in others. The Ohio area shifted from oats to soybeans and wheat, and to more of all kinds of livestock. Corn replaced the tobacco in Wisconsin and the area shifted still more to dairying.

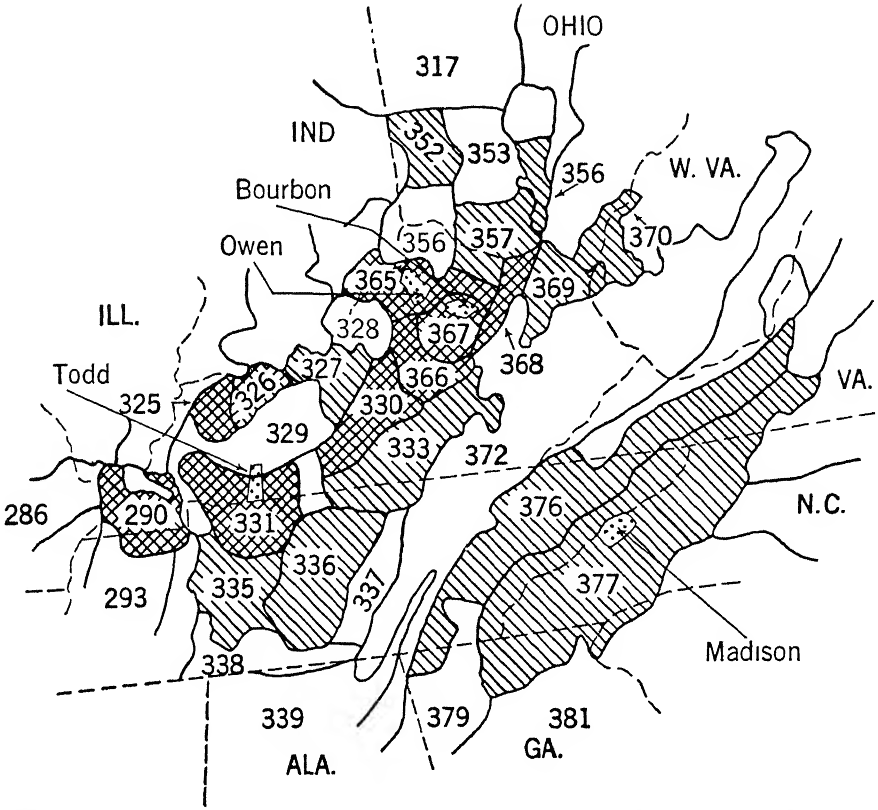

CHART 53. Type-of-farming areas growing tobacco in Kentucky and adjoining states, together with the location of four of the representative counties listed in Table 34. In the darker-shaded areas, tobacco is the main source of farm income.

Dark-Shaded Areas

290 Purchase — tobacco (fire-cured), some dairy and livestock

325 Henderson — tobacco (fire-cured), general, livestock

326 Owensboro — tobacco (Green River), livestock, some dairy

330–331 The Pennyroyal Area — tobacco (burley, fire-cured), general, livestock

365–366 The Outer Blue Grass — tobacco, livestock, general

367 The Inner Blue Grass — tobacco, livestock, horse farms, country estates

368 Kentucky Highlands — tobacco, general, self-sufficing

Light-Shaded Areas

327 Louisville Milkshed — dairy, tobacco

333 Cumberland Valley — self-sufficing, general, tobacco

335 Western Highland Rim — Self-sufficing, general, some tobacco

336 Central Basin of Tennessee — livestock with some dairy, tobacco, and cotton

352 Miami Valley — general, livestock, dairy, cash grain, tobacco

356 Cincinnati Milkshed — dairy, tobacco, general

357 Maysville—general, tobacco, livestock

369 Ashland — self-sufficing, general, some tobacco

370 West Virginia–Ohio — general, tobacco, self-sufficing

376 Tennessee Valley — general farming, with tobacco in a minor role in three subareas

377 Appalachian — self-sufficing with tobacco in two subareas

TABLE 34. THE ORGANIZATION OF LIVESTOCK-TOBACCO FARMS IN SIX AREAS AND IN SIX REPRESENTATIVE COUNTIES, 1929

	Inner Blue Grass, Ky.	*Outer Blue Grass, Ky.*	*Penny-royal Plains, Ky.-Tenn.*	*Appa-lachian Area, N. Car.*	*Miami Valley, Ohio*	*Vernon County, Wis.*
Type number of area	367	365	331	377b	352	269
Percentage of farm land in:						
Crops	31	23	46	26	68	41
Pasture	65	70	32	41	25	10
Corn	10	7	16	8	27	9
Tobacco	6	4	5	2	1	2
Oats					11	7
Wheat					11	
Hay					10	20
Other cash crops	4		2			
Percentage of farms:						
General	10	28	13	14	48	17
Cash-grain	1		1		10	
Crop-specialty	55	36	59	29	8	20
Dairy	3	1	2	0	7	55
Self-sufficing	5	12	11	35	3	2
Animal-specialty	10[a]	9	2	3	9	2
Percentage of income from:						
Tobacco	34	37	48	27	10	22
Other cash crops	2	—	3	—	20	2
Livestock	41	26	15	14	22	15
Livestock products	6	8	6	3	18	40
Family living	8	22	17	38	13	15
County	Bourbon Ky.	Owen Ky.	Todd Ky.	Madison N. C.	Miami Ohio	Vernon Wis.
Average farm:						
Total acres	85	91	93	62	84	122
Value of farm	$14,700	$4,300	$2,600	$2,200	$8,800	$9,300
Value of product	$3,060	$1,070	$990	$600	$2,090	$2,120
Value of equipment	$510	$180	$140	$60	$670	$750
Tobacco farms:						
Value of product	$2,540	$1,340	$1,150	$750	$1,770	$2,480
Number of milk cows	1.9	2.0	1.8	4.7	2.4	7.8
Number of other cattle	2.5	2.1	2.1	2.1	2.4	8.9
Number of sows or gilts	0.9	0.3	0.3	—	0.7	0.7

[a] Horse farms included.

The most important management problem of nearly all tobacco areas is adjustment to fluctuating demands. Not only the Pennyroyal, but the Purchase area, the Maryland area, and the flue-cured areas to some extent, have been dependent on foreign-controlled export markets. Changes in domestic smoking habits have favored the flue-cured and burley tobacco growers since World War I.

Also, the tobacco growers have tended in the past to expand their production and depress prices severely, and not to contract their production much at the lower prices. The reason for this in some areas has been that their tobacco provided them about the only way of employing family labor left over from the other farm operations; in others, that tobacco has furnished the major part of their cash income; and in others, that all the competing uses of the land were much less intensive and produced much lower incomes per acre. Most types of tobacco had large carry-overs in 1929 when the Federal Farm Board was created to deal with this type of problem. The Big Depression of the thirties followed at once. The controls imposed by the A A A aided greatly in adjusting production to market outlets, but did not induce enough of the needed accompanying changes in farm organization. Many of the Kentucky and Tennessee tobacco farms need the same type of reorganization as outlined for the piedmont cotton farms in Chapter XIII. They need enough crop and pasture land to support livestock enterprises that will produce the major part of their income, so that they can grow tobacco only as a supplementary cash crop. As the farms are now set up, however, the growing of tobacco on a few of the level acres contributes importantly to the maintenance of the soil on the farms as wholes, since it reduces the cropping of the hillsides.

In Kentucky, Tennessee, and the mountain areas, the cattle enterprise is often a mixture of dairy and beef cattle. The cows may be of dual-purpose type, the calves being hand-fed and later fattened for sale as yearlings. But often instead a beef bull is used with dairy cows and all the calves are fattened. These first generation crosses do not make the best type of animal for fattening, but animal husbandmen do not find it easy to prove that this practice is uneconomical in many areas. A second alternative, however, has been gaining in favor in recent years on the farms with good pastures and more feed grain — this is to sell the calves as young veals and buy enough beef-type calves and yearlings to utilize the available feeds. The cows of dairy breeds produce more milk than the usual beef-type cows, and the purchased beef cattle are also of a higher quality than the usual home-raised animals. With the dairy and beef-cattle enterprises thus running in parallel

rather than combined, both grain and roughage make a larger return. Only on the farms with more than the usual amount of cropland can corn be raised to fatten hogs.

The Wisconsin and Ohio tobacco areas have the alternative of intensifying their livestock farming as a way of increasing their farm income. By growing more alfalfa and ensiling more corn or other forage, and buying a little more protein supplement, many farmers now would obtain as much income as from their present dairy-tobacco combination. At least, such farmers should have the data at hand that will enable them to determine whether such an organization will not promise to reward them best at the relative prices in prospect at the time. The tobacco crop always has conflicted with the corn crop in these areas. It has often been noted that the farmers with the least tobacco have the cleanest corn fields.

A special problem of the Blue-Grass areas is that much of the land needs to be kept in grass cover as much as possible to prevent further sheet erosion of the relatively shallow soils overlaying the limestone.

DAIRY-POTATO FARMS

The combination of dairying and potatoes is much like the dairy-tobacco combination considered in the last section. Its habitat, however, is in the northern latitudes where corn does not mature enough for grain. The farms nevertheless need a cultivated crop. Enough small grain can usually be grown to provide the bulk of the dairy concentrates. Corn silage helps greatly in many such areas, and clover or alfalfa in others. In northern Europe where corn cannot be grown even for silage, and labor is cheaper, special types of potatoes are grown in large volume as feed for cattle. They compete as a cultivated crop with mangel-wurzels and fodder cabbage.

Very little space need here be devoted to analyzing dairy-potato farms, since both potato and dairy farming have already been discussed. The potatoes are usually grown in the same rotation with small grain and hay and corn for silage. In the lighter soil areas of the Great Lakes states, rye is often included in the rotation as a companion crop for clover. The labor on the potato crop fits in with that on small grain and hay and dairying almost the same as does the corn crop in the southern part of the Great Lakes states. The work on corn and potatoes overlaps somewhat at planting, cultivating, and harvesting times.

In five dairy-potato areas that may serve as examples, one in south central Maine, one in central Michigan, two in northern Wisconsin,

and one in east central Minnesota, from 20 to 49 per cent of the farms were classified as dairy in 1929, and from 5 to 29 as potato farms. The remainder of the farms were mostly general, that is, with dairying and potatoes in about even balance. They averaged 118 acres, of which only 30 acres were in crops, 12 acres in corn and oats, 5 acres in potatoes, and the rest in hay mostly. Much of the 50 acres of pasture was wooded. The 5 acres of potatoes produced a fourth of the farm incomes; livestock products, 35 per cent; and meat animals, 8 per cent. The farms growing potatoes commercially averaged more than 5 acres of potatoes per farm, however, and those classified as potato farms still more. These averaged 5 milk cows and 6 other cattle. Except in Maine, the potato farms had larger incomes than the average for their counties.

In all these areas, the acreage of potatoes declined in 1929–1939, and the acreages of corn and hay increased, and except in Maine, the number of cows milked. This suggests that intensive dairying is crowding in on the potato enterprise in these areas, as it is on tobacco in southern Wisconsin.

THE MIXED FARMING OF THE NORTHEAST

The mixed farming areas of the northeastern quadrant of the United States can be singled out on the map as those having a high proportion of general farms. In five of them selected for special study, dairy farms were the next most numerous group in 1929 except in the cattle-raising Virginia Shenandoah Valley. The crops combined with dairying in western New York are potatoes and field beans mostly; in eastern Pennsylvania, potatoes and cash grain; in the Shenandoah Valley of Maryland, cash grain and some potatoes; and in Michigan, cash grain, field beans, and potatoes. The dairy production on these farms is for eastern fluid milk markets and will be discussed in Chapter XLII. The cash grain is mostly winter wheat, grown on some farms mainly because particular farmers have more land than they care to work intensively, or because it fits into a rotation especially well. Field beans in the past were a type of cash crop intermediate in intensity between potatoes and wheat and supposedly suited to lighter soils. Mechanization has now made them at least as extensive as corn.

THE MIXED FARMING OF THE PACIFIC STATES

No two of the Pacific Coast farming areas with a mixed pattern of farming answer the same description. Thus, in the Willamette Valley of Oregon, the combination is dairying, fruit, and a little cash grain;

in the Klamath Basin of Oregon, it is range livestock, potatoes, and dairying; in the Ellenberg area of central Washington, it is livestock, dairy, potatoes, and cash grain; in the Sacramento Valley of California, it is rice, barley, livestock, and fruit; and in the San Luis Obispo area in the Southern Coastal Plain of California, it is fruit, truck crops, field beans, and dairying. Not all of these, of course, are found on the same farms. Often in this region the climatic conditions within a range of a few miles vary so widely that the farming system changes almost completely. Some of the farms carry on more or less parallel enterprises on different parts of these farms which have different soil or topographic or moisture conditions — rice and barley, for example. Many of the combinations are with fruit and vegetable production, which will not be considered until Part V. Only in the Willamette area are the farms of the sort which we have been considering in other areas. These averaged 104 acres in 1929, had values of product of around $2,000, and kept around ten head of cattle. In the other four areas, the farms ranged in size from 400 to 750 acres, and had products worth from $4,500 to $11,000. Most of the real crop-and-livestock farming of the West is found in the irrigated valleys and will be discussed in Chapter XXXIX.

FURTHER READING

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* David L. MacFarlane, Ernest J. Nesius, Charles R. Sayre, and Robert E. Graham, *Agriculture of the Kentucky Pennyroyal Plain*, Kentucky Bull. 461, 1944.

* Aaron G. Nelson and Gerald E. Korzan, *Should Farmers Emphasize Wheat or Livestock in North Central South Dakota?* South Dakota Circular 33, 1941.

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EXERCISES

1. Set up complete farm budgets for the Sargent County sample farm, (1) selling as much grain as possible, with only a minimum number of livestock, and (2) selling little or no grain, but expanding livestock enterprises to utilize farm-produced feed. In addition to differences in net income, what other advantages and disadvantages has each?

2. Set up a farm budget for a mixed farm with which you are personally familiar, or obtain the data for one from some published or unpublished source. Set up alternative budgets with larger and smaller acreages of the chief crops, and with more and fewer of the chief kinds of livestock, to ascertain the effect upon farm income, total labor requirement, and labor distribution.
3. Reconstruct the farm budgets presented in Kansas Bull. 312, using average prices for 1943–1944. What differences do these prices call for, compared with those for 1924–1938?
4. Why are specialized crop farms and specialized livestock farms found in the areas where crop-and-livestock farms predominate?
5. Which farms in your community are the more specialized, the large or the small ones? How do you explain any differences which exist?
6. In what ways does land ownership, inheritance of land, and other tenure factors affect the type of farming in the Corn Belt?

CHAPTER XV

Production for Use of the Farm Family

THE AGRICULTURAL PRODUCTION WHICH WE HAVE BEEN CONSIDERING in the last nine chapters has been mainly for the market. Before going further with our analysis, we need to consider the noncommercial production of farms — the part of the farm output which is for the use of farm families. This is a larger part of the farm income than is ordinarily realized, and than is indicated by the census figures that we have been using. The census obtains its figures by valuing the noncommercial production as if it were commercial; that is, the food and fuel used by the farm families at what they would sell for if they were sold in the market and hauled there besides. This involves an untrue assumption, of course, since much of the food and fuel would never have been produced for market.

Our concern here is with the worth of these products to the farm families. If a farm family does not produce its own supply of potatoes, it must ordinarily buy them at the price prevailing in the local stores, and in addition transport them from the local market to the farm. The same is true with butter, eggs, meats, fruits and vegetables, and all other products that may be either produced at home or purchased at the local market. For all foods combined, retail prices in cities were 2.4 times as high as prices received by farmers in the years around 1940. But retail prices are somewhat higher in our large cities than in the smaller cities and towns in which farm families do most of their buying. Farm families, moreover, are sometimes able to buy products from their neighbors at prices lower than the store prices — they may, for example, be able to buy their butter at a local creamery.

Some allowance also needs to be made for the transportation costs both of hauling produce to market and hauling home supplies. The cost of hauling produce to market is difficult to estimate, and much of the time the trip to buy meats, butter, fruits, and vegetables in the local stores would have to be made anyway to obtain groceries and other supplies. But these products are mostly of sorts that cannot be stored,

and if the farm family is to have them without producing them, it must make more trips to town for them than for groceries in general.

The 1940 census, using the method above described, placed a value of $1,132,000,000 on the farm products consumed on the farms where produced. This was 14.5 per cent of the total value of farm production. If these products had been valued at their worth *to the farm family at the farm*, that is, what they would have cost them if they had bought them, they would have represented 25 to 30 per cent of the total.

The farm also provides the family dwelling. The Bureau of Agricultural Economics has allowed $665,000,000 as the rental value of farm buildings in its estimates for 1940. This looks like a very moderate allowance — only about $9 rental per month. Similar dwellings in cities and villages with the same facilities rent for considerably more than this. They are really not much nearer in time, though perhaps in space, to the stores, schools, doctors, hospitals, libraries, daily papers, electricity, radio broadcasts, and the other amenities of urban life than are farm dwellings served by automobiles, telephones, radios, and electricity. At any rate, the differences between farm and city living in these respects are disappearing rapidly.

REGIONAL DIFFERENCES National figures conceal the wide differences in the value of production for home use between the highly commercialized farming regions and the regions with low incomes still relatively isolated. Table 35 presents the same data for selected states. The farms of California mainly specialize in fruit, nuts, vegetables, poultry, and the like, and produce few commodities for home consumption. The relatively low estimates for the Deep South reflect the prevailing low levels of living, particularly of housing, on farms in this region. Iowa, Wisconsin, and New Hampshire rank high because the dairy products, meats, and eggs that are produced for the market are also available for home use. In terms of percentages of the total farm income, the range is from 11 per cent in California to 52 per cent in Tennessee. Within the state of Iowa, the figure for Van Buren County was 26 per cent, and for Clay County, 12 per cent. In Ohio the range was from 39 per cent in Monroe County to 13 per cent in Madison County.

The differences are still more evident by the types of farming of the 1930 census when their production is figured on the same basis, as in Table 36. The specialized poultry, truck, fruit, and cotton farms, in the order named, produce the least for direct use of the family; and the livestock and general farms the most. The self-sufficing farms come close to being exactly that — their commercial production is only

TABLE 35. RELATIVE IMPORTANCE OF FARM PRODUCTS CONSUMED BY THE FARM FAMILIES, IN SELECTED STATES, 1939

State	*Income per Farm From:*				*Home Consumption and Dwelling Rental as a Percentage of the Total*
	Farm Marketings	*Home Consumption* [a]	*Rental of Dwelling* [b]	*Total*	
California	$3,530	$250	$180	$3,960	11
Iowa	2,450	480	210	3,140	22
Montana	2,060	410	100	2,570	20
Oregon	1,610	380	110	2,100	23
Kansas	1,330	330	130	1,790	26
Wisconsin	1,300	430	170	1,900	32
New Hampshire	1,190	460	150	1,800	34
Ohio	1,110	370	140	1,620	31
Virginia	630	500	110	1,240	49
South Carolina	630	350	60	1,040	39
Tennessee	440	420	60	920	52
Mississippi	390	310	40	740	47

[a] With farm products consumed by the farm family valued at twice the census figures.
[b] Estimated by the method used by the Bureau of Agricultural Economics.

18 per cent of their total production. The abnormal farms are mostly part-time farms.[1]

THE ROLE OF PRODUCTION FOR FAMILY USE The production on farms for home use, however, means much more to agriculture than can be indicated by a mere comparison of values. The simple fact is that very many farm families cannot afford to buy meat, butter, cheese, eggs, potatoes, and vegetables if they do not produce them themselves on their own farms. They simply do not have cash enough with which to buy them. One quarter of the farm families in the United States had farm incomes of less than $300 in 1939, including the value of products consumed by the family as valued by the census.[2] Probably half of the farm families in the United States do not sell enough commercial products to obtain the cash with which to buy adequate amounts of the foods named.

[1] None of the foregoing estimates includes the earnings of members of the farm household at labor off the farm, or income of the farm family from pensions or interest on accumulated savings. Rough estimates as to the amount of such income range from $200 to $250 per family per year. Such income is, of course, not income from farming.

[2] Part of these also had off-the-farm earnings and other nonfarm income.

TABLE 36. RELATIVE IMPORTANCE OF FARM PRODUCTS CONSUMED BY THE FARM FAMILIES, BY TYPES OF FARMING, 1929

Type of Farm	*Income per Farm From:*				*Home Consumption and Dwelling Rental as a Percentage of the Total*
	Farm Marketings	*Home Consumption* [a, b]	*Rental of Dwelling* [a]	*Total*	
General	$1,180	$600	$120	$1,900	38
Cash-grain	2,670	540	130	3,340	20
Cotton	850	360	40	1,250	32
Crop-specialty	1,700	460	90	2,250	24
Fruit	3,160	390	190	3,740	16
Truck	2,670	420	140	3,230	17
Dairy	2,470	590	180	3,240	24
Animal-specialty	3,330	610	180	4,120	19
Stock-ranch	6,890	580	130	7,600	9
Poultry	1,770	440	160	2,370	25
Self-sufficing	140	560	60	760	82
Abnormal	860	440	130	1,430	40

[a] See Table 35 for footnotes.
[b] Value of production for home use, the only measure of such production generally available, is indeed a poor yardstick when applied to regional differences in such production. The important thing is production and use in relation to needs. Such a determination was made for eight Southern states for 1937. If farm families in these states had produced and consumed all of the farm-grown products they needed in that year, an additional 5.8 million acres of cropland and 8.7 million acres of pasture would have been required. The rank and file of cotton farmers can go a long way in increasing their production of vegetables, eggs, milk, and meats without adding anything to market supplies.

It is sometimes said that if farmers directed all of their efforts to production for the market, they would have more cash income. But commonly this is not true. It surely has not been true on half of the farms of the United States between the two world wars. During most of this period, agricultural production has been pressing upon the market, and prices of farm production have been so low that if farmers in general had endeavored to increase their incomes by producing more for the market, they would have depressed prices still further and might well have reduced their cash incomes. This was especially true in the years from 1931 to 1940. In only one year in that period, namely 1937, did the market appear able to absorb all that the farms produced.

Under such circumstances, farm families increase their real incomes if they devote enough labor and other resources to supplying family needs almost as fully as possible. By so doing, they buy less of the products of other farms, it is true, and the market demand for food will be

reduced a little. But agriculture will not be paying the large cost of assembling and distributing these products.

During the 1930's, moreover, there was much under-employment on farms. Several million workers were remaining on farms because unemployment was still high in the cities. Each year many thousands who went to the cities seeking work were obliged to return to the farms. Under such conditions, to use a little of the land on farms along with the labor not fully employed, to produce food and fuel for the farm family, is a way of using the farm resources more fully that adds to the real income of farm families in the most effective way possible.[3]

Again, even though many farm families can afford to pay cash for meats, dairy products, fruits and vegetables, in case they do not produce them, they are not likely to do so freely enough to assure the family an adequate diet. If they have these available on their farms, they eat them much more liberally. Thus the farm family which has a small orchard, with no more than a dozen apple, pear, plum, and cherry trees, and a small planting of strawberries and raspberries, will consume two or three times more of these in season than if it has to buy them in the local stores. It will also can many more of them and have them available for use throughout the year. The new developments in quick freezing, combined with the increased availability of electricity on farms, will increase still further the advantage of producing these fruits on farms.

Quality is a further factor. Both the flavor and the food values in fruits and vegetables produced in the home gardens are greatly superior to those that are produced at a distance and stand around in containers or on display for days before they are consumed. The differences between fresh and market stocks of sweet corn, peas, and cabbage are always a great surprise when discovered anew.

The opportunity which living on a good farm affords to have an abundance of the foods necessary for a good diet, and also to eat for pure enjoyment, it should be apparent, is one of the great advantages of life on a farm. Many farm families, in addition, derive considerable satisfaction from the growing of fruits and vegetables for themselves. The boys and girls on farms find work in the garden and caring for poultry more interesting and educative than the monotony of cotton chopping or picking or work on tobacco and sugar beets.

A large fraction of our farm families, however, for one reason or

[3] Around five million, mostly young men and women, left the farms for the armed services and for city occupations during the war years, and still agricultural production expanded rapidly.

another, are passing up this opportunity in part, if we may judge by the surveys of farm family diets that have been made. The circumstances that cause them to do so are in part suggested by Tables 35 and 36. A highly specialized farm enterprise needs to go out of its way much more to produce milk, meat, eggs, fruits and vegetables, than one which is producing many of these for the market anyway. Such a farm may need special equipment just for the garden, and to buy feed especially for the poultry and pigs. As more farms become completely tractorized, this will be even more true. Without a horse and a walking one-row cultivator, the labor of caring for a garden is greatly increased.

The principal reason for the decline of farm orchards and small-fruit gardens is the increase of plant diseases and pests, and the need of special knowledge and often equipment to combat these. The commercial apple grower may spray his trees ten times or more during a season. To watch a dozen assorted fruit trees and spray each of them at the right time calls for more attention to detail than many families can afford. Lack of rainfall is a retarding factor in much of the West; and early and late frosts in the North. So far as latitude is involved, Virginia and Tennessee seem to be situated best for garden vegetables and fruits. The deep South can have the best fall, winter, and spring vegetable gardens.

Some of these handicaps, however, are on the way toward being partly overcome. New powerful insecticides are coming on the market, new handy small-scale sprayers, new motorized garden cultivators, and the like.

NUTRITIONAL STANDARDS

The essentials of good human nutrition are the same as those for good animal nutrition. Students who have calculated rations for livestock are thus familiar with the procedures involved in calculating rations for people. The daily *maintenance* requirement for a man weighing 170 pounds is 1,400 calories or 1.4 therms of net energy. The maintenance requirement for a 1,000-pound horse is given by Morrison as 7.0 to 9.0 T D N's, or 5.6 to 7.2 therms of net energy. A hard-working horse needs only 6.4 additional therms, according to the Morrison tables; but a hard-working man may need three or four times his maintenance requirement.[4]

The nutrition scientists of this country have preferred not to speak of food "standards" or "requirements." Instead, the Food and Nutrition

[4] *Feeds and Feeding*, Appendix Table III.

Board of the National Research Council has set up a table of *Recommended Daily Allowances* of calories of food energy, and of proteins, calcium, iron, and five of the vitamins, thiamin (B_1), riboflavin, niacin, ascorbic acid (Vitamin C), and Vitamins A and D, for a man weighing 70 Kg. (167 lbs.), a woman weighing 56 Kg., and for children of various ages, at three levels of activity.[5] These allowances include a margin of safety of 20 to 30 per cent for most of the ten items in the table. This margin is intended to take care of persons whose needs for food are unusually high because of unusual exposure to the weather, or of the hazards of disease, or because their bodies do not assimilate some of the food elements fully. It is also considered desirable to have reserves of some of the vitamins in the body ready to be drawn upon in case of illness or unusual strain upon the body. The table is not intended to allow for wastes in handling and losses in cooking and serving foods, but in effect it does this in part because of the safety factor included. Let us consider briefly the different nutrients in the human diet.

Food Energy. The Recommended Daily Allowances of food energy range from 2,500 calories for a sedentary male worker to 4,500 for a very active one, and from 2,100 to 3,000 for women workers. Chart 54 indicates how the calorie and other allowances vary by age and sex. There will be weeks on some farms when men work twelve hours or more at heavy labor and may need 6,000 calories daily. At slack seasons, they may not need more than 3,000 calories. The allowances for the United States Army during the war were around 3,800 calories. For the average man, woman, and child in the United States, 2,530 calories would measure up to the Recommended Allowances, leaving a margin of safety of perhaps 300 calories.

All foods provide energy, but the fats have it in much more concentrated form than the carbohydrates. A pound of lard or vegetable oil supplies 4,080 calories; a pound of flour or similar food, around 1,600; of lean meat, 1,200; of potatoes, 325; and of vegetables, from 200 downward. A hard-working person must obtain his energy in considerable part from concentrated foods. A man cannot begin to do as much hard work on roughages as can a horse.

Proteins are needed to build and maintain the body tissues. A growing boy or girl needs much more protein than a very active man or woman. Low-income populations obtain their proteins mostly from cereals and dried beans and peas. To provide all the essential amino acids, however, the diet must also include dairy products, eggs, and/or lean meats,

[5] *Recommended Dietary Allowances*, National Research Council, 1945.

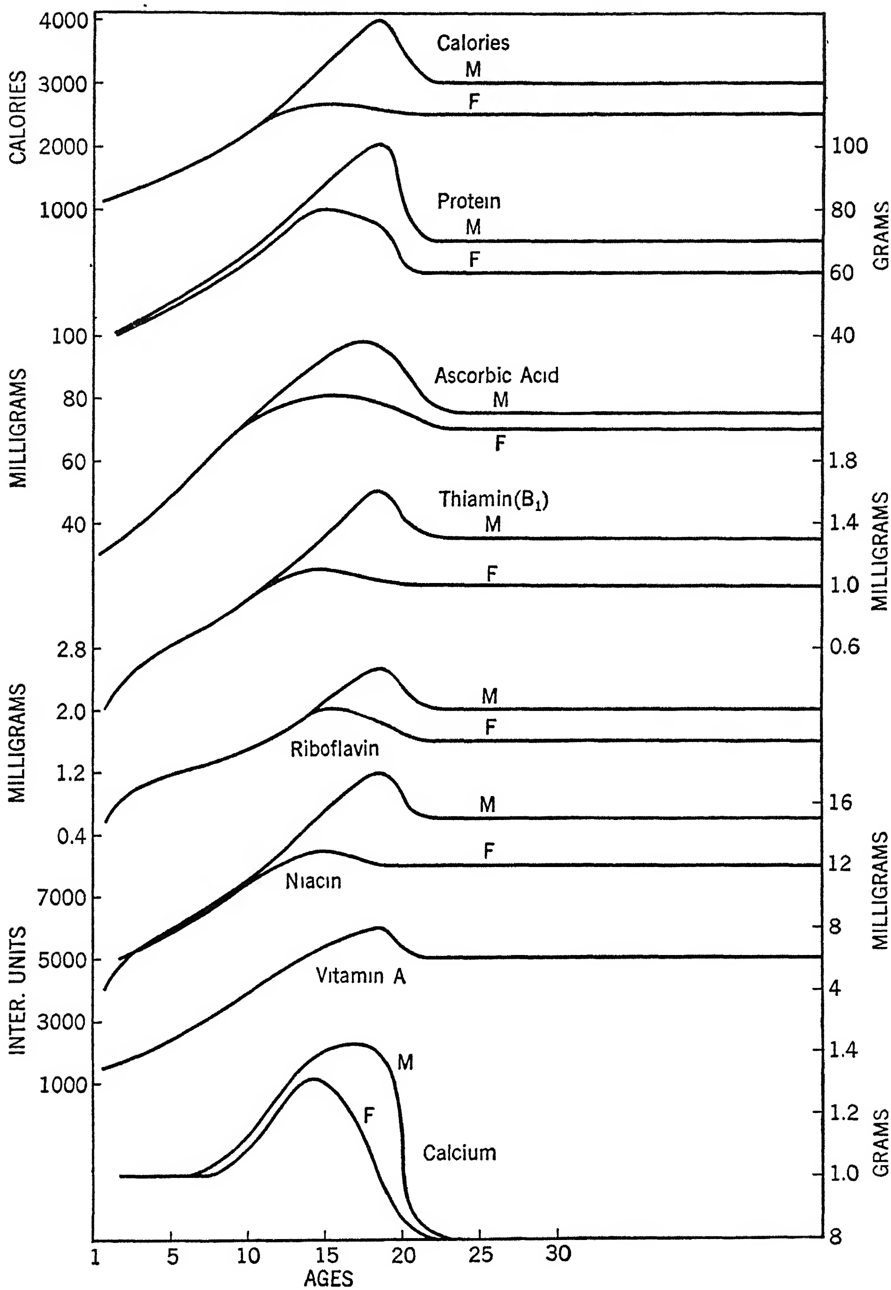

CHART 54. Recommended Daily Allowances of the National Research Council adjusted for the ages of children, male and female separately. The published table of allowances gives averages only by age-groups. The adjustments in this chart were made by the authors on the basis of general suggestions made by Dr. Philip Jeans of the Iowa City Hospital.

poultry and fish, or as cheaper substitutes, soybeans and peanuts, also classified as "complete" proteins. One may judge as to the foods required to provide an adequate daily supply of protein from the following combinations:

Combination 1. 1 pint of milk, 1 egg, $\frac{1}{2}$ pound of meat or fish, 8 slices of white bread, 1 helping of cooked cereal

Combination 2. 1 quart of milk, 1 egg, $\frac{1}{2}$ pound meat or fish, 6 slices of white bread

Combination 3. 1 pint of milk, 1 egg, $\frac{3}{4}$ pound meat or fish, 6 slices of white bread.

Minerals. The body needs many minerals for proper growth and maintenance, but ordinarily sufficient quantities of all of them are present in a mixed diet, except sometimes of calcium and iron. Additional calcium may need to be provided for growing children and nursing and expectant mothers. About three fourths of all the calcium consumed in this country comes from milk. In parts of the country where soils are badly leached, as on the Southern Coastal Plain, not only calcium and iron, but phosphorus, copper, and several other trace elements may be lacking in locally grown vegetables and fruits, with the result that anemia is widespread.

The *vitamins* are essential to proper use of food by the body, and to normal growth and health. Their importance can scarcely be overemphasized. A varied diet, adequate on other grounds, with strong emphasis on vegetables, fruits, and milk, is likely to contain enough vitamins. The Vitamin A needed daily is provided by a half cup of cooked spinach, or of turnip greens, mustard greens, chard, or stewed apricots, or a cup of cooked carrots, or two sweet potatoes. For small children, the most certain source is cod liver or other fish oil. The amounts of Vitamin A in milk and dairy products makes a significant addition to the diet, but a whole quart of milk supplies less than one third of the Vitamin A needed. One orange or grapefruit provides one day's supply of ascorbic acid; or two or three tomatoes, raw or canned; or almost any diversified diet of fruits and vegetables.

Many foods contain thiamin, but in relatively small amounts, so that if enough is provided, the diet needs to be rather diversified. Also, unless it includes such foods as lean meat, milk, oranges, and "enriched" or whole wheat bread, a deficiency is likely to result. One pork chop contains about one fourth of the Recommended Daily Allowance; a quart of milk, or six slices of enriched bread, one third. The most important source of riboflavin in ordinary diets is milk. Other good sources

are green leafy vegetables and lean meats. The lack of niacin causes pellagra. Corn meal is particularly deficient in niacin and this contributes to the prevalence of pellagra in the South. Niacin is most abundant in eggs, lean meats, milk, and in certain of the green and leafy vegetables.

ADEQUACY OF THE DIETS OF FARM FAMILIES

The nation-wide survey made of food consumption in this country in 1936 showed that farm families on the average fare better than city families because the milk, eggs, and meat which they produce at home are good sources of nutrients often lacking in low-income city diets.[6] But this survey showed that a fifth of all the families studied were not consuming enough of one or more of the seven nutrients listed in the table of Recommended Allowances. The average farm family was consuming, per person, a third more milk and potatoes, and a sixth more fats, and almost half more flour, corn meal and other cereals, and beans and peas, than the average city family; but a third less meat and green leafy vegetables, 60 per cent less tomatoes and citrus fruit, and a half less of other fruits. A more sketchy survey made in 1942 showed increased consumption on farms of milk, beans, green vegetables, tomatoes and citrus fruits, and eggs, but decreased consumption of meats and of other fruits.[7]

Average food consumption figures, however, are not very meaningful. Consumption of most of the nutrients above the Recommended Allowances adds little if anything to well-being. Consumption above the average, therefore, does not offset the bad effects of consumption below the average. A study of 13 poorly fed, 35 better-fed, and 23 best-fed farm families in Florida in 1940 showed these wide differences in annual consumption per person:

	POORLY FED	BETTER FED	BEST FED
Milk — *qts.*	137	265	320
Eggs — *doz.*	17	27	35
Meats — *lbs.*	102	141	199
Butter — *lbs.*	5	16	19
Vegetables — *lbs.*	307	541	589
Fruits — *lbs.*	10	35	46

Differences in diets may prevail by areas. A careful dietary study in 1942–1943 of 200 rural families in Wayne County, North Carolina, in

[6] *Consumer Purchases Study, Family Food Consumption and Dietary Levels*, Farm Series, Miscellaneous Bull. 405, U.S.D.A., 1941.

[7] Esther F. Phipard, "How Good Is Our National Diet?" *The Annals*, January, 1943, pp. 66–67.

the Coastal Plain tobacco-cotton section, showed large deficiencies in the diets. For example, 40 per cent of the white families and 50 per cent of the Negro families consumed less than a half of the Recommended Allowance of Vitamin C; half of both groups, less than half the thiamin allowance; 30 per cent of the white families and 40 per cent of the Negro families, less than half the calcium allowance; and 40 per cent of the first group and 50 per cent of the second, less than three fourths of the protein allowance. A parallel study of 200 rural families in 1943–1944 in industrialized Alamance County, North Carolina, showed relatively few families living dangerously below the allowance levels. The Alamance families were eating enriched wheat bread in place of corn, and considerably more of meat, milk, vegetables, and fruits.[8]

Dorothy Dickins of the Mississippi Agricultural Experiment Station found in 1938–1939 that a half more of the share-croppers than owner families were not consuming enough milk; a third more, not enough meat; and ten times as many, not enough fruit. The share-renter families were about halfway between the owners and croppers.[9]

PLANNING FAMILY FOOD PRODUCTION

If the food consumed by the family is a fourth of the total farm production, it is surely worth as much careful planning as most of the farm enterprises. Decisions need to be made as to what foods to produce for the family, and how much to produce of each.

WHAT FOODS TO PRODUCE The theoretical solution of the problem of what foods to produce for the farm family, and in what amounts, is obvious enough. It is simply to multiply the amounts in the table of Recommended Allowances, adjusted for age as in Chart 54, by 365 days to get them to an annual basis, and then take a table giving the amounts of calories, protein, calcium, Vitamin A, etc., in the different foods that can be produced on one's farm, and figure out for each month what combination of such foods will supply the quantities of each nutrient needed. For several reasons, however, this procedure is not feasible. For one, it does not allow for the foods that are better bought than home-produced. A large fraction of the farms of the United States could grow wheat and take it to a local mill, if there were a mill, as a majority

[8] These studies were made by D. F. Milam, Wm. J. Darby. and R. K. Anderson, under the auspices of the Rockefeller Foundation, the North Carolina Board of Health, and Duke University.

[9] Dorothy Dickins, *Improving Levels of Living of Tenant Families*, Mississippi Bull. 365, 1942.

of Southern farmers still do with corn. But most Northern farmers have a better use for their land and labor.

Practically speaking, moreover, decisions as to when to produce and when to buy, can seldom be reduced to definite terms. To be sure, calculations can be made as to the returns from labor used in producing food for the family and in producing for the market. Thus Tiffany and Reid, by obtaining a record of the time spent on fifty Iowa farm gardens, and valuing the vegetables and fruit at what the families would have paid for them, estimated a return of 58 cents per hour.[10] They could even have done this for each vegetable and fruit separately. But still they could not really have determined whether it was good family practice for any family to grow its own potatoes or apples or strawberries. The family could record the out-of-pocket expenses of any item of production for home use, the amounts of it consumed, what it would have cost if bought, and the hours spent on it at what periods of the year. Such data would enable it to arrive at more informed judgments. But this is more figuring than most families have time for — they had better be out working in the garden instead. Conceivably, the experiment stations might find it worth while to assemble data of this kind.

For those foods which are also produced for the market, the decision as to what to produce for the family is made at the same time as the other; but by no means always independently of it. Many farm families would keep no poultry except that they want a supply of fresh eggs and poultry meat, and having this much of a flock, they decide to keep enough more to have some eggs to sell. One cow does not provide year-round dairy products for a family, and two cows usually produce more than a family needs part of the time. A two-cow herd tends to grow into a three- and four-cow herd. In the same way, the pigs raised for the family larder may become a sow and litter of pigs.

With enterprises which produce both for the family and for market, an issue often arises, on low-income farms especially, as to how much to withhold for the use of the family. A pressing need for cash may cause products to be sold which the family greatly needs. Surprisingly little fresh milk and cream are family-used on many dairy farms.

Another type of situation is that in which a food cannot be produced profitably for market, but may be produced to good advantage for home use. Thus the area may be too remote from market for commercial potato growing, and yet may produce excellent potatoes for home use. Many fruits and vegetables answer this description. Or it may be that

[10] Margaret E Tiffany and Margaret G. Reid, *Some Farm Family Gardens Pay in Dollars*, Iowa Research Bull 322, 1943.

the feed supply is too limited for a commercial dairy, poultry, or hog enterprise, but enough to produce for family use.

The consumption of farm-raised meat is often restricted by the relatively large size of most meat animals. A full-grown steer or cow will provide 500 pounds or more of meat (dressed weight), which is more than a year's consumption of beef for the average family. For this reason, home consumption of farm-raised beef is considerably reduced on many Western cattle ranches. Some ranches keep a small flock of sheep mostly so as to have meat during the year. On farms elsewhere with cattle, this difficulty is partly overcome in the winter months by exchanging quarters of beef with neighbors, or selling extra quarters locally. The 1936 survey of food consumption cited above reported farm families consuming two or three times as much poultry meat as city families — chickens come in smaller sizes than cattle, hogs, or lambs.

Storage is an important factor in determining what foods can be produced for home consumption. Pork was once consumed in large quantities on northern farms in the summer — and still is on southern farms — because it can be salted or smoked. The root cellar still serves importantly for potatoes and other root crops. Home canning has been helped by the pressure cooker, and the frozen-food locker and home-freezing units make it possible to store foods never before stored and to preserve their quality better.

WHAT AMOUNTS TO PRODUCE Once it is decided what foods to produce on the farm, the amounts needed could be calculated from the tables of allowances and of nutrient values of foods. But this is a task that extension workers ordinarily should perform for farm families by preparing tables suited to different sections of their states and different levels of income. Table 37 places in parallel the tables thus prepared for South Carolina, Washington, and Vermont. The classification followed is that used for South Carolina. All pork is included with meats in the Washington column, and salt pork with bacon in the Vermont column. The lists of vegetables and fruits of course differ in the three states. Large differences appear in the amounts of fruits and meats. The Vermont column separates purchased from home-produced foods. The estimated cost of the purchased food at 1934 retail prices was $184, including $30 for butter, which most dairy farmers buy at the creamery or store.

Several comments on this table are needed. The first is that all three assume a farm family eating an abundance of dairy products, meat and eggs, and except in South Carolina, of fruits, because they can be pro-

duced on the farm and the family can afford to produce them. The South Carolina budget even assumes that the corn meal and wheat will be produced on the farm. If some of these were bought, as in the case of butter in Vermont, less is likely to be consumed. In spite of the desirability of having an abundance of all these foods, many individual farm families have other uses for their land and labor which mean more to the well-being of the family. Low-income families have to choose between food and such essentials as medical and dental care, bare minima of shelter and clothing, and education. They may substitute more dry beans and peas and even cereals for some of the more expensive foods listed and still have *adequate diets at low cost* as distinguished from the *adequate diets at moderate cost* that are provided in the three budgets. Furthermore, beans, peas, and cereals are cheap foods to buy.

TABLE 37. FOOD BUDGETS PROVIDING ADEQUATE DIETS AT MODERATE COST, AS DESIGNED FOR FARM FAMILIES IN SOUTH CAROLINA, WASHINGTON, AND VERMONT

Food	*South Carolina*	*Washington*	*Vermont*	
			Produced	*Bought*
Milk	455 gals.	365 gals.	415 gals.	——
Butter	130 lbs.	130 lbs.	——	94 lbs.
Cheese — cottage and other	——	90 lbs.	13 lbs.	——
Fat back, bacon, and lard	130 lbs.	110 lbs.	154 lbs.[a]	——
Lean pork, fish, beef, and game	270 lbs.	575 lbs.	220 lbs.	74 lbs.
Poultry	120 lbs.	150 lbs.	75 lbs.	——
Eggs	150 doz.	150 doz.	150 doz.	——
Potatoes, sweet or Irish	650 lbs.	850 lbs.	860 lbs.	15 lbs.
Dried peas, beans, peanuts, soybeans	90 lbs.	50 lbs.	63 lbs.	33 lbs.
Tomatoes or citrus fruits	500 lbs.	500 lbs.	400 lbs.	65 lbs.
Green, leafy, and yellow vegetables:				
Greens, collards, cabbage, string beans, carrots, yellow squash, leafy lettuce, etc.	500 lbs.	210 lbs.	550 lbs.	60 lbs.
Other vegetables:				
Turnips, onions, corn, okra, butter beans, beets, cucumbers, squash, pumpkins, etc.	500 lbs.	725 lbs.	340 lbs.	18 lbs.
Fruits:				
Blackberries, huckleberries, figs, plums, strawberries, grapes, scuppernongs, apples, pears, peaches, melons	500 lbs.	1250 lbs.	700 lbs.	110 lbs.
Syrup	15 gals.	12 gals.	37 gals.[b]	6 gals.
Sugar or honey	200 lbs.	300 lbs.	30 lbs.[c]	230 lbs.
Corn meal, grits, rice, wheat, flour, oatmeal	750 lbs.	750 lbs.	——	895 lbs.

Source: *Better Farm Living and Food for Victory*, South Carolina Extension Service Circular 232, 1944. *What the Farm Should Contribute toward Family Living*, Washington Popular Bull. 163, 1941. Dorothy Emery, *A Food Budget for Vermont Farm Families*, Vermont Bull. 393, 1935.

[a] Includes salt pork. [b] Maple sugar. [c] Jellies and jams.

Second, these food budgets provide for 100 per cent of the Recommended Allowances. Something less than this is reasonably safe on a majority of farms, at least in the short run. In cases where about all that is involved in providing the 100 per cent is using some time of members of the family that otherwise would not be fully engaged, the full 100 per cent is a proper standard. But on many farms other things will be more important than the last 10 or 15 per cent.

Third, the budgets are commonly calculated by taking the average amounts for an adult person and multiplying them by the number of persons in the family. Some adjustments upward on some of the items may be needed if the children are 15 to 21 years old, and downward if they are under 10 years, as indicated by Chart 54.

Fourth, food budgets need to be adapted to the particular foods most easily produced in a state or section of a state. They need to be different for western Washington where many species of fruits and vegetables flourish than for eastern Washington with less than 18 inches of rainfall. They need also to take special advantage of foods that are indigenous to an area, or that have become well established in the diets. Nutritional surveys have discovered, for example, that quinoa, which grows on the high Andean plateau of western Bolivia, and is consumed by the native Indians as a cereal, is a much better food than the wheat that the merchants try to sell them; that some of the native plants and seeds eaten freely in some of the interior dry areas of Mexico are excellent sources of the calcium needed to take the place of milk in the diet, as well as of the vitamins.[11] The corn which is so important in Southern diets is an excellent food if not degerminated and if supplemented by the right combination of other foods. Several Southern states are now requiring the enrichment of corn meal the same as of white flour. One of the important reasons for production for family use in some regions is to correct deficiencies in diets introduced by use of artificial highly refined foods like white flour, corn meal, and sugar.

THE PRODUCTION PLAN A food budget is useless without provision for getting the food produced. The South Carolina and Washington food budgets are accompanied by full details as to production, canning, and storing. Table 38 reproduces the production plan to go with the South Carolina food budget, even including feed for the mule needed for the field work. Plans of this sort have been worked out for many families receiving F S A loans.

[11] Including especially malva, an uncultivated foliage plant, charal, sesame seed, calabaza seed, and piñon nuts.

The canning program to go with this budget calls for 100 quarts of tomatoes, to be used three or four times a week over a period of eight months; and for 120 quarts of other vegetables, 120 quarts of fruit, 20 quarts of kraut, and 50 quarts of meat.

Obviously, such a plan needs to be coordinated with the plan for the rest of the farm operations. If this were done, it might well appear that the two acres used to produce the twenty-five bushels of wheat could be better used to grow more cotton or tobacco to increase the cash income of the farm. This alternative could be explored by budgeting the receipts and expenditures of the farm with the wheat and with the cash crop. The advisability of keeping more hens or fattening one more hog could be analyzed in the same way.

TABLE 38. PLANTING PLAN TO SUPPLY FOOD FOR A FAMILY OF FIVE AND FEED FOR THE NECESSARY LIVESTOCK

	Garden space	*Corn*	*Wheat*	*Oats*	*Cane sorghum*	*Grazing*	*Permanent pasture*	*Legume hay*	*Cottonseed meal*
	Acres	*Bu.*	*Bu.*	*Bu.*	*Gals.*	*Acres*	*Acres*	*Tons*	*Lbs.*
Potatoes, sweet	$\frac{1}{4}$								
Potatoes, Irish	$\frac{1}{8}$								
Tomatoes	$\frac{1}{8}$								
Other vegetables	$\frac{5}{8}$								
Cereals		12	15						
Syrup					25				
Feed for 25 hens		36	10			$\frac{1}{4}$			
Feed for 2 cows		18		40		1, small grain 1, millet [d]	4	4	800
Feed for 3 hogs [a]		45				$\frac{1}{4}$, oats $\frac{1}{4}$, soybeans			100
Fruits [b]									
Feed for 1 mule [c]		60					2	3	
Total									
Amounts		171	25	40	25				900 [e]
Acres	$1\frac{1}{8}$	10	2	2	$\frac{1}{4}$	$2\frac{3}{4}$	6	7	

Average yields per acre for South Carolina — 1930 census:

Corn . . . . 14.4 bu. Oats . . . . 23 6 bu.
Wheat . . . . 9.7 bu. Legume hay . . . . 1.0 ton

[a] In order that pork may be produced economically, some protein supplement must be fed to balance the corn.

[b] One acre is suggested for all fruits and vegetables, since in the general garden the late summer and fall vegetables will follow the spring vegetables — corn after Irish potatoes, tomatoes after turnips, beans after spinach.

[c] If oats are fed to the mule, deduct one bushel of corn for each 2 bushels of oats fed.

[d] Millet follows small grains on same land. Soybeans follow oats on same land.

[e] One thousand pounds of cottonseed will yield around 450 pounds of cottonseed meal.

Production for home use presents special difficulties in the Great Plains. Procedures for meeting these have been developed at the experiment stations. One of these is to establish a windbreak with inside rows of the special hardy types of fruit trees that have been bred, and inside these the rows of small fruit, and then the vegetables. These windbreaks also catch the drifting snows and increase the ground moisture. Another procedure is to establish a garden just below the earthen dams that are built across draws to make stock-ponds.

FARM SECURITY ADMINISTRATION PLANNING FOR FOOD PRODUCTION The low-income families receiving loans from the F S A since 1935 are particularly in position to benefit from food budgeting and production planning. Ordinarily their diets are inadequate, and they have the time needed for food production and processing because their farms are small. They lack the capital to acquire the necessary livestock, fertilizer, seeds, and equipment, and often do not know how to care for livestock and a garden. All "standard" F S A loans made in recent years are based on a home-management as well as a farm plan. The home plan includes a form which lists the foods in six groups and usually has the following headings: "Our family should use:", "We plan to use:", "We plan to produce:", "We plan to buy:", and "Our farm needs to provide:". Under the last heading is spelled out the production plan — the number of cows, hogs, hens, fruit trees, etc. Both amounts and costs of the purchased foods are indicated. Another section outlines the canning program.

These plans are worked out either in individual or group conferences, with farmer and housewife both participating, and are revised each year until the loan is repaid. The plan at the start frequently does not provide for using or producing all the food that should be used, but each year it comes nearer to it. Thus an Appalachian family that started with 1 cow, 1 hog, and 25 chickens and did very little canning, by 1945 had 3 cows, 2 hogs, 70 hens, and was planning to can 800 quarts — it had passed from a deficit to a surplus family. An extreme case is a Virginia Negro family of fourteen that started in 1935 with 1 cow, 10 hens, 2 hogs, and 250 quarts canned, and in 1945 was using the output of 3 cows, 50 hens, killing 6 hogs and 1 calf, and canning 1,100 quarts. Nearly a half million farm families had standard F S A loans in 1940–1941.

JOINT USE OF FACILITIES BY FARM AND FAMILY Closely related to production on farms for the use of the family is a large amount of joint use of facilities, beginning first with the farm dwelling which houses

the farm working force. The coming of the automobile expanded this joint use in a way that has been very important for farm life and farm work. One can ask a farm family to keep a record of all the trips that are made largely on farm business and largely on family affairs, but the count will fall far short of reporting the true situation. The telephones added further to these facilities, and in the past decade, electricity. In 1919, less than 100,000 farms were being supplied with electricity from central systems. In the twenties, the numbers increased at the rate of only 50,000 a year. From 1929 to 1941, more than a million more farms were supplied. A survey made in 1941 showed that 90 per cent of the farms with electricity had radios; 85 per cent, electric irons; 55 per cent, washing machines; 42 per cent, refrigerators; 21 per cent, vacuum cleaners; 18 per cent, electric water pumps; 17 per cent, utility motors; 15 per cent, hot plates; 11 per cent, poultry house lighting; and 8 per cent, cream separators. But these statistics fail to furnish the full account of the joint use of electricity on farms.

FURTHER READING

Recommended Dietary Allowances, National Research Council Reprint and Circular Series No. 115, 1945.

Food and Nutrition, American National Red Cross Pamphlet, Revised, January, 1942.

* *A Food and Nutrition Program for the Nation*, National Planning Association Planning Pamphlets 46, 1945 (25 cents).

* Oscar Steanson and E. L. Langsford, *Food, Feed, and Southern Farms*, U.S.D.A., 1939.

EXERCISES

1. Draw up a table showing the total farm production for home consumption, seasonal availability of various commodities, and method of storage or preservation, for a typical farm in your home county.
2. What proportion of the total recommended annual food allowances does this farm production of food provide for the farm family on this farm?
3. Based upon your general observation and upon any studies available, what are the most common and the most serious dietary deficiencies in your home county?
4. Draw up a table similar to Table 38, but for your home county, showing acreages and production of food for home consumption, on the scale which you judge to be most economic for this locality.
5. In addition to the value of the food produced, list and discuss other economic advantages from farm production of food rather than its purchase.

Part Three

PRINCIPLES AND METHODS OF ANALYSIS

Not always, of course, does the prevailing pattern of farming in the area accord with the economics of the situation. Economic factors may have changed, and most of the farmers in the area may not have adjusted their farming to the changes. In such a case, the operator who departs from the prevailing pattern, *provided he does so in the right direction*, will make a larger net income than his neighbors and will be able to outbid them for land.

The procedures for determining what is the right direction in which to depart from the prevailing pattern, and for deciding generally how a farmer needs to change his enterprise or combination of enterprises to meet a change in economic or other factors, have been outlined in Chapters VII, VIII, and IX for farmers specializing in one product, and in Chapters X to XV for farms producing two or more products. In general, this method has been to pre-estimate the probable receipts and expenditures and net income of promising alternative enterprises or combination of enterprises. This method is commonly referred to these days as the *budget method*. It has also been called the *method of substitution*,[1] and the *synthetic method*.[2] This method, however, is not mechanical. It requires judgment as to what directions of change are likely to appear most promising when budgeted; and exercising this judgment effectively calls for a general understanding of the principles which determine what lines of production have the advantage in the particular circumstances in a given area and on a particular farm. It is the purpose of this chapter to outline these principles. They have been introduced in the earlier chapters, mainly under the heads of *relative* and *comparative advantage*, the first having to do with comparisons of advantage in production of different products in any one area, and the second with comparisons of the sets of relative advantages, or ratios of advantage, of competing areas. We need now to examine these comparisons of advantage much more carefully.

FACTORS DETERMINING RELATIVE AND COMPARATIVE ADVANTAGE

In one place or another in earlier chapters all the factors have been named that help to determine advantage in producing any form of crop or livestock. These factors can be roughly classified as *physical*, *biological*, and *economic*. The dominant physical factors are familiar to

[1] John D. Black, *Production Economics*, Chapter 9.

[2] John D. Black, Editor, *Research in Farm Management*, p. 124 ff. Also see John B. Hutson, *Progress in Development of Budgeting Method of Planning in Agricultural Economics* (Ph.D. Thesis, Columbia University, published in 1930).

all. They include climate, which in turn includes temperature, growing season, amount of sunlight, rainfall, and prevailing winds; and topography and soils and the other factors associated with these, such as drainage and erosion. Differences in these not only set direct limits on the crops that can be grown, but indirectly over the centuries have helped to determine the characters of the soils. Surface evaporation must be considered along with rainfall. Because it is greater in the South than in the North, crops can be grown with less rainfall in the northern Great Plains than in the southern. The spring-wheat region therefore extends clear across northern Montana, whereas winter wheat mostly stops in western Texas. The growing season establishes the northern limit of cotton growing in Virginia and Tennessee, and of corn growing in Wisconsin and Minnesota. Difference in climate may be highly local. Peaches are grown on the east side of Lake Michigan but not on the west. In the severe winter of 1928–1929, the olive trees of Italy were killed only at the foot of the slopes where air drainage was impeded. A long hillside in California may grow a succession of fruits.

Soils differ broadly by regions in the same manner as climate does, and in part along with climate. The soil scientists have grouped the soils of the United States, more or less on a regional basis, into forty-six different groups.[3] The southern limit of glaciation in the Corn Belt marks off distinct differences in the character of the soils; likewise the transition from coniferous to mixed hardwood to hardwood forest in the East, and in the Southeast from flatwood to lower coastal plain, to upper coastal plain, to piedmont and to mountain. But local variations are more important with soils than with climate. These tend to form regular patterns on residual-soil terrain — like the succession of soils from the Inner to Outer Blue Grass to the Eden Shale formation in Kentucky — and broken patterns on glaciated terrain. The local variations in the latter may be so great that a single township often has six or eight soil series, and a single farm two or three of them and a half dozen soil types. The particular combination on any farm of soils, of rough, rolling, and level land, and of upland and moist lowland, has much to do with determining its optimum combination of lines of production. In the Corn Belt, for example, cash crops are likely to be produced on farms with mostly level land, milk and hogs on the somewhat rolling farms, and beef cattle on those with large acreages of rough permanent pasture.

[3] Charles E. Kellogg, Misc. Pub. 229, U.S.D.A., *Development and Significance of the Great Soil Groups of the United States* Also see Charles E. Kellogg, *The Soils That Support Us*, Chapters 6–10, New York, The Macmillan Company, 1941.

How the boll weevil has forced cotton growing more to the north and west since 1915 is familiar to all; likewise how discovery of the cause and nature of blackhead disease of turkeys has made commercial production possible. There would be no commercial cranberry growing today except for the disease and pest control methods that have been developed. Hybrid corns are pushing the limits of corn growing northward, and they are likely to push it southward also. Biological factors will have more to do with location of the production in the future than they have in the past.

Economic factors in location of production tend to have a pattern which differs from that for the physical and biological factors. Thus, prices of products and of supplies tend to be related to markets, consuming centers, and transportation; wage rates, labor supply, and labor skills to the density and character of the population and the location of industry; interest rates and the availability of credit to risk and uncertainty and type of credit institution. Economic conditions on individual farms, however, such as the family labor available, opportunities for off-farm employment, the particular abilities of the individual farmer, or the ability or willingness of the farmer to borrow the capital required in order to shift from cash-crop to livestock farming, may be more determinative than over-all market and price factors.

In diversified agriculture, as important as any of the factors named are the supplementary, complementary, and joint-product relationships among the enterprises. Whether or not soybeans can be fitted into the work program of a farm better than can oats or barley or winter wheat may be more important than relative prices in determining whether or not they will be produced in an area.

Economic and other factors commonly operate together. The east-west boundary between wheat and corn is determined by both rainfall and the relative prices at any period. Climate and the boll weevil similarly interact with prices in determining where cotton growing will be expanded or contracted.

None of the factors influencing location is altogether stable. The economic factors are only less stable than the others. The patterns of change vary for the different factors, as explained in Chapter VI. The changes introduced by plant breeders often decrease the comparative advantage of the areas which in the early years furnished ideal growing conditions for the crops. The corn and the soybean crops have moved north, west, and south as strains have been developed which are suited to the formerly border areas. The general effect of mechanical inventions thus far, however, has been to increase the comparative advantage

of the more level areas. Developments in terracing and contour farming are changing these comparisons. At the start the new machines also favored the larger farms, but the middle-size and larger farms are now pretty well equipped and the farm machinery manufacturers are giving attention to machines for smaller farms. These small farms will not be able to use machinery as effectively as the larger farms, but they will be at less disadvantage than they were.

In spite of the economic and biologic changes that have been occurring, the general features of many of our systems of farming have remained about the same for several decades. The present systems are the result of generations of farm experience in adapting farming programs to the particular soils and climatic hazards, to the relative prices, and to the marketing facilities available in the community. Large groups of farmers have found that these systems of farming afford the best utilization of their resources. At any rate, if they are not the most profitable, the burden of proof is usually on the side of one who recommends a change. There is a certain parallel with what is sometimes referred to as the advantage of an early start in industry. Once a city has developed a body of trained experienced workers, and the rest of the country has come to look to this city for this commodity, and the market and trade channels have been developed, any new city which undertakes to break into this field has some great handicaps to overcome; likewise, any new industry which undertakes to break into a community which has long specialized in another line of production. Dairy farming is thus handicapped when it undertakes to break into the cotton regions of the South; or when it encroaches upon wheat growing or beef raising elsewhere.

GEOGRAPHICAL PRICE AND PRODUCTION PATTERNS

We need to examine more carefully the patterns of the economic factors determining location of production. Surrounding any market are more or less concentric production and price zones. The net prices received by fluid milk producers around a city decrease cent for cent with the hauling charges; similarly, out from Chicago the net prices received for hogs, beef, and wheat with the freight charges. Since the largest deficit areas for butter are on the eastern seaboard, butter prices decline from New York and Philadelphia westward, until a "divide" is reached, beyond which butter is shipped to a higher-priced deficit area on the west coast. In 1939, Chicago butter prices averaged 0.6 of a cent a pound lower than New York prices, and San Francisco prices 2.3 cents higher than Chicago prices.

The price pattern with competing markets is a modification of the foregoing. The difference between the price of hogs in the South St. Paul market and the Chicago market is ordinarily less than the cost of shipping hogs from South St. Paul to Chicago; it is instead the difference between shipping to South St. Paul and to Chicago from border territory between the two market areas. Although Minnesota potatoes are not shipped to New York, they compete with those from New York and Pennsylvania because potatoes from intervening areas in Wisconsin and Michigan may go either to Chicago or to eastern markets according to whichever offers the better price. Hence, potato prices all the way from Maine to Minnesota are part of one price system. The farm prices of potatoes in 1939 averaged \$.50 per bushel in Minnesota, \$.55 in Michigan, \$.90 in Pennsylvania, \$1.00 in Connecticut, and \$.70 in Maine. Although no milk is shipped from Michigan to Boston, prices in the two markets are tied together by the fact that Vermont milk may go either to Boston or to New York, and western New York and Pennsylvania milk may go either east or west, and likewise milk in northwestern Ohio. The farther west that the Boston milkshed pushes, the more the New York milkshed pushes into the Pittsburgh and Cleveland milksheds, and the Cleveland milkshed in turn into the Detroit and Indianapolis milksheds.

The Russian geographers use the term "economic profile" in this connection. They mark off a strip of territory east, west, north and south out from a large city like Moscow and record the prices of different products along these strips. These prices are checked against the theoretical prices, that is, Moscow prices less cost of transportation, and the differences are analyzed. In the first zone east of Moscow toward Orenburg, the prices are very close to the theoretical prices. In the second zone, local factors produce important modifications. In the third zone, the prices are higher than in the second because of the influence of the Volga River cities and trade outlet. The prices are lowest of all and most stable in the fourth zone, beyond the Volga River, except for a few products that are exported by way of the Black Sea or imported in the same way. A somewhat similar profile could be laid out west of Chicago to San Francisco. For deficit products, prices will be highest at the Continental Divide in Colorado; for surplus products, lowest. Prices in San Francisco are high for products which must come from inland, but low for those which are received by boat.

Accompanying these zones of price are zones of production. In the immediate environs of a city located in the humid or semi-humid regions of the northern half of the United States, a belt of truck and small

fruit farms is invariably found. Interspersed with these farms, and just beyond them are the market-milk farms. Commercial poultry farms producing strictly fresh eggs for the local market may be intermingled with the market-milk farms. Outside the strictly market-milk areas usually is found a somewhat narrower zone within which the milk is converted to fresh cream for city consumption before it is shipped to the city. Seasonal variations in milk production, and institutional controls of one kind or another, as we shall note in Chapter XLII, may disturb greatly the pattern of this cream zone.

The factors determining the order and the width of the zones surrounding a city are mainly these:

1. *Perishability* of the product — in the modern world, better designated as *loss in quality*. To be strictly prime in quality, strawberries and raspberries should ripen fully on the vines and be consumed on the same day that they are picked. More than half the sugar in sweet corn is converted to other forms such as starch within a day after the crop is gathered, and similarly with peas. Most fresh vegetables lose their crispness within two days after harvesting.
2. *Value per pound or bushel.* The lower such value of a product, the closer to the point of consumption it tends to be produced. This is why fluid milk comes from the inner zone, cream from the next, and butter from still farther out.
3. *The conversion factor* — that is, the weight lost in processing before shipment. Cream loses a large fraction of the weight in the whole milk. Cheese loses more than cream, and the butter around 95 per cent of the weight of the milk. For this reason, cream is hauled longer distances to local butter plants than is whole milk to cheese plants. A first processing has already taken place on the farm.

In dairy areas, one will find condensed and evaporated milk plants within and beyond the cream zones. They need regular daily deliveries of whole milk the same as do cream-separating plants, and they need it in larger volume. Whether butter or cheese is produced outside the cream and condensed milk zone depends upon the climate to some extent — the American types of cheese require a cool summer climate — but fully as much upon other local factors. The cheese plants are smaller than the butter plants.

Beef-cattle areas tend to be farther away than hog areas because more feed is required to produce a hundred-weight of beef than of pork — the conversion factor is higher. Wool is produced farther out than beef because of its high value per pound. Wheat and other food grains tend to be produced well out from market because of their ready transport-

ability and storability, and because they are somewhat higher in value per pound than competing feed grains.

To explain some features of the distribution of grain and livestock production, however, a further step in the analysis is needed, namely, the reasons for the location of processing plants. The German economist, Alfred Weber, in his book *The Location of Industry*, laid the foundation for such analysis, as did the German, Von Thünen, in his book *The Isolated State*, for the analysis of location with respect to markets. The parts of Weber's principles that are immediately significant, when adapted somewhat to suit our purposes, are the following:

1. *Products that lose much weight in conversion are likely to be processed near their points of production.* This accounts for the location of butter and cheese plants close to the farms, and of slaughtering plants relatively near to the hog- and cattle-producing areas. Sugar-beet and sugar-cane factories for this reason are especially likely to be located near to the farms.
2. The obverse of the foregoing is that *products losing little weight tend to be processed where other needed factors, such as labor, power, and fuel, are most abundant*, the product itself exercising little influence on location. Cotton and wool weigh about the same after being made into yarn or cloth as before, and therefore are processed near to sources of labor and power. The wheat flour made from wheat weighs around 70 to 75 per cent as much as the wheat, and the rest of the wheat goes into by-products. The milling industry therefore tends to be located as much with respect to points of consumption as with respect to points of production.
3. Along with weight-losing must be considered *the relative costs of transporting the product before and after it is processed.* If the difficulties and costs of transport are greater after processing than before, the processing tends to take place near the consumer. Freight rates on clothing are higher than on cotton, on refined sugar than on raw sugar. Beef does not need to be fed after it is slaughtered, nor does it suffer shrinkage and death losses in transit; but it does require refrigeration in transit.
4. *Cities develop and populations "agglomerate" at points on trade routes that represent breaks in transportation.* The major type of such a break occurs at seaports or lake ports like New York, Galveston, and Chicago. A similar break occurs at the fall line on rivers which marks the head of river navigation. Another such break occurs at inland points where local produce is assembled, these points commonly being the junctions between local and long-distance routes. Agglomerations

also develop at or near large sources of weight-losing raw materials such as coal and iron or equivalent water power.

However they develop, these cities provide labor for the processing of farm products and frequently cheap power, and at the same time local consuming outlets. They therefore tend to attract industries processing foods and fibers which lose little or no weight.

5. Scarcely mentioned by Weber is the circumstance that *some raw materials need to be processed while in a fresh condition.* This accounts for the location of fruit and vegetable canneries near the producers.
6. In earlier times, industries tended to be located near sources of food supply since the food consumed by laborers was in effect highly weight-losing. The large cities of the ancient and medieval world were mostly at or near areas of fertile land. London and Paris are good examples. Hauling food by wagon and oxen for a city like Boston was a costly enterprise. One of the reasons that New York outstripped other eastern cities with the building of the Erie Canal was that the canal barges brought in abundant supplies of food. Since the coming of steam power, transport of food by land and sea has become easier than the transport of coal, iron, and lumber. Food, therefore, is now being moved to the sources of power and other weight-losing materials.

THE GEOGRAPHICAL PATTERN OF COSTS

That prices decline outward from a market or consuming center is generally recognized by farmers. They do not commonly realize that total costs decline along with prices because of increasing hauling charges. If this were not so, the "profit" would be greater farther out from market and the production would shift in that direction. The particular cost which is most likely to decline is rent, for the rent of land and the price of land tend to be the capitalized value of the income from the land after all the other expenses are paid. Rents and land prices therefore tend to be high near markets and lower farther away. If a dairy farm in McHenry County, Illinois, producing milk for the Chicago market and renting for $6 an acre were equidistant from Philadelphia, it would probably rent for $10 an acre. But other costs are lower too. Wage rates will usually be somewhat lower, but the principal reason for lower labor costs will be that machinery and power will be substituted for labor. Farming tends to be labor-intensive near cities, and capital-intensive away from them. Some of these differences may be concealed by differences in the quality of the land; a high yield per acre may enable

Idaho potato farmers to compete with those in Wisconsin and still pay higher rents. Or the distant area may not use any commercial fertilizer.

THE PRINCIPLE OF COMPARATIVE ADVANTAGE

By this time, the reader should have clearly in mind the meaning and significance of the principle of comparative advantage. Earlier chapters stated this principle and applied it repeatedly. This chapter has described the conditions under which it operates. In Chapter VIII, we saw the Black Prairie of Texas being devoted almost entirely to cotton, although the yields were much lower there than in the Delta, because the yields of all other crops in the Black Prairie — corn, for example — were still lower as compared with their yields in other areas. Under a similar set of comparisons, we saw, in Chapter XIII, cotton being grown on the High Plains of Texas. Similarly for wheat in Washington-Oregon and on the Great Plains. We learned from these examples that it is not only the yield of a crop as compared with its yield in other areas that determines what crops will be grown in an area, but also its yield as compared with that of other crops in the same area; and that comparative advantage thus involves a two-way comparison, between areas, and between different crops in the same area. These relationships can be boiled down to the statement that *a product tends to be produced in those areas where its ratio of advantage over other areas is higher, or its disadvantage is lower*, than for any other product. A ratio is a one-way comparison. Comparing two ratios gives a two-way comparison.

Then in the chapters on diversified farming, we had occasion to speak of comparative advantage when two or more crops are grown in the same farming system in various combinations of crops and livestock, with significant complementary and supplementary relationships between them; and to say that the simplest way to apply the principle in such situations is to consider the alternative crops and livestock combinations exactly as if they were separate individual crops. This means treating a corn–oats–clover rotation and a corn–wheat–clover rotation as if they were two different crops such as corn and wheat.

It should be at once apparent to a student of elementary economics that the patterns of price and cost around a market or consuming center present a typical supply-and-demand equilibrium situation. The more acres of suitable land within reach of a consuming center, the larger the supply that the producers stand ready to produce and offer for sale at a schedule of prices. Similarly, the larger the body of consumers to be supplied from the producing area, the larger the quantity of the

product that these consumers stand ready to take at this same schedule of prices. At some price, assuming a freely competitive market, the amounts produced and consumed come into equilibrium. This price will be lower than some of the potential producers can afford to produce for, because some other uses of their land and labor will return them more. Some who would produce potatoes in the Red River Valley of Minnesota if the price were higher find that cows or sugar beets pay better. Or potential fluid-milk producers find that selling to a condensery pays better. Similarly, some of the consumers who would buy more of the product if it were cheaper decide to spend their money for some other food.

The equilibrium price which comes to prevail may shut out some of the potentially producing areas altogether, or it may only reduce the amount which they produce. If potato prices were higher, Clay County, Minnesota, might plant 40,000 acres in place of the 29,600 acres planted in 1939. If the equilibrium price were to fall, because demand fell off, or some other areas improved their methods so that they stood ready to supply more at a given schedule of prices, Clay County would find itself shifting its least-qualified potato farms to some other products, or reducing the acreage of potatoes on these farms. Complementary and supplementary relations have much to do with how much or little an enterprise will be expanded or contracted in an area with changing prices. If contracting it leaves a vacant place in the work program, or in the rotation system, it will be contracted very little with lower prices.

The following analysis in terms of potatoes may help us to see how the relationships involved in comparative advantage with many competing areas fit into the conventional pattern of supply and demand. Let us say that seven potential potato-producing areas in the United States, named S to Y in the table following, are capable of producing, respectively, in millions of bushels: S, 80; T, 60; U, 120; V, 60; W, 60; X, 90; Y, 130, or a total of 600 million. The most that consumers have ever used is 530 million bushels at the very low price of $.35 per bushel. At $.80 per bushel, according to the demand Curve MN in Chart 55, consumers will use 325 million bushels, and at $1.20 per bushel, 250 million bushels. At $1.20 per bushel, however, the potato farmers, according to the supply Curve OP, would within a few years expand their output to the full 600 million bushels. At $.80 a bushel, their output is 305 million bushels; and at $.50, it is 105. The prices of potatoes will tend to reach an equilibrium at around $.82 per bushel, the point of intersection of the supply and demand curves; and at this price production would be 320 million bushels.

Obviously, some of the seven potential producing areas will be shut out of the market. Which will it be? According to Table 39, Region S has a 3 : 1 advantage over Y in potato production, and the comparable ratios for the other six regions are T, 2.7 : 1; U, 2.4 : 1; V, 1.9 : 1; W, 1.7 : 1; X, 1.4 : 1; Y, 1 : 1. The first four in this list have a potential

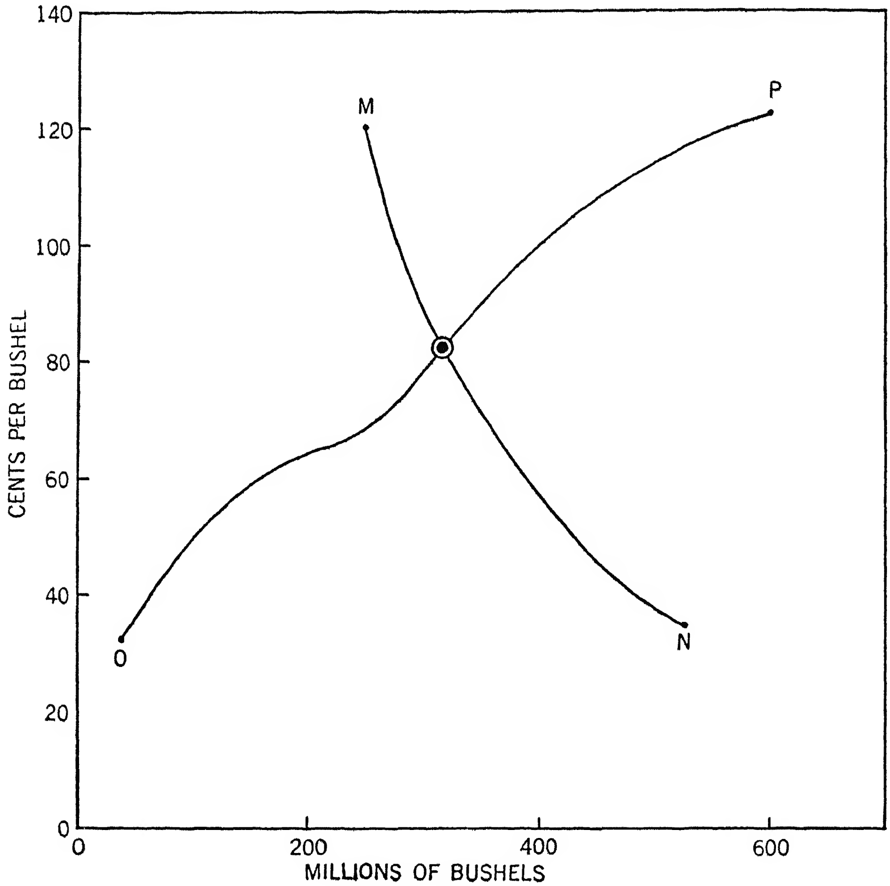

CHART 55. Supply and demand curves for potatoes, and their equilibrium point, according to the data in Table 39.

potato production of 320 million bushels, and 320 bushels are needed at $.82 a bushel. But the comparison of advantage must be made the other way, with each crop competing with potatoes in each region. Potatoes in Y are used as a common standard for both comparisons. The standard can be thought of as the output of potatoes per combined unit of land, labor, and capital in Y. In two regions, T and Y, the

ratios of advantage are higher for other crops than for potatoes; and peaches and potatoes are on a par in W. The four regions left, S, U, V, and X, can produce 350 million bushels, and consumers will take only 320 million bushels at $.82 per bushel. Region W will therefore be kept in peaches, unless the demand for potatoes rises, and some of V will grow potatoes. Should the demand for sugar rise, however, V would all stay in sugar beets, and Y would produce some potatoes.

TABLE 39. POTENTIAL POTATO PRODUCTION AND RATIOS OF ADVANTAGE FOR SEVEN REGIONS (HYPOTHETICAL)

Region	*Potential potato output*	*Ratio of advantage over Y*	*Ratios of advantage of crops competing with potatoes in each region over potatoes in Y*			
S	80	3.0	Sugar beets	2.0;	Alfalfa	1.8
T	60	2.7	Tobacco	3.0;	Corn	0.8
U	120	2.4	Hay	1.0,	Oats	1.0
V	60	1.9	Sugar beets	1.6;	Small grains	1.4
W	60	1.7	Peaches	1.7;	Beans	1.2
X	90	1.4	Rye and clover	0.6;	Oats	0.5
Y	130	1.0	Corn	1.1,	Hay	0.8

To bring this demand-supply analysis into line with actual conditions, Regions S to Y will need to be thought of as producing potatoes in combination with other products in rotation systems. In Region U, which resembles Aroostook County, Maine, System A, consisting of clover cut for hay one year and then plowed under for potatoes, would produce 150 million bushels with a ratio of advantage of 2.7 according to the method of ratings followed above; System B, consisting of oats, clover, and potatoes, would produce 100 million bushels with a ratio of advantage of 2.3; and System C, a four-year rotation, would produce only 75 million bushels with a ratio of 1.8. Competing cropping systems are similarly possible in Region X, which resembles the central Wisconsin potato area; in Region S, which suggests the Western irrigated areas; in Region V, which suggests the Red River Valley area; etc. From a complete array of the competing cropping systems including potatoes in these regions, and from the accompanying ratios of advantage, can be put together a set of cropping systems and areas that will supply 320 million bushels or any other amount desired. The demands for the other products in these cropping systems will determine the cropping systems and areas as well as the demand for potatoes.

In many concrete situations, the principle of comparative advantage is easier to apply in some other form than in the one given above. An alternative form which is frequently useful is called the *law of first choice.* It runs as follows: *Any product for which only a limited area is available in proportion to the need for it will have first choice of this area.* Cotton and corn once illustrated this principle excellently. Until a few generations ago, it could be said that any land which was well suited for growing cotton would be used for this purpose because cotton has very specific climatic and labor requirements, and no large areas meeting these conditions were available outside the United States. Additional areas have now been developed so that much land which could grow cotton is no longer needed for it. Similarly, the price of corn rose more rapidly than other prices in the United States from 1895 to 1920 because only a limited amount of land has the hot days and nights, relatively high summer rainfall, and fertile soils required for corn. Substitutes, mainly vegetable oils, have now replaced corn in some measure, and the demand for corn is no longer pressing upon the limited corn areas.

Even more particular about its climate and soil is coffee. For a long time, it had first choice of the large area devoted to it in Brazil. Cotton is now able to out-compete coffee in parts of the former coffee area.

In all these three cases, however, the land which is really well adapted to the dominant crop is certain to be used for it, whereas in the case of products like potatoes which have a very large potential area in proportion to the volume of them which the population will consume, only the areas with a high ratio of advantage will be used for them. Dairy farming belongs in the same bracket as potatoes — any land which will produce grass is potential dairy-farming land.

The simple rule commonly followed by the man on the street which brings him completely into line with the principle of comparative advantage is this: *Buy anything which you can buy more cheaply than you can produce it.* Applied to agriculture, this causes the New England dairy or poultry farmer to buy his concentrates because they can be produced more cheaply on the more fertile lands of the Midwest than on the leached soils of New England.

This rule is frequently advanced as a reason that farm families should buy their eggs rather than produce them, or their potatoes, or even local fruits and vegetables. This may represent a wrong application of the rule. The costs that are balanced against prices paid for such products need to be carefully weighed. A careful budget analysis might show that many dairy farms in the Northeast by improving their pastures and developing legume forages such as alfalfa and ladino clover would save

much more on feed bills than the additional costs involved. Hundreds of thousands of Southern cotton farms can probably produce feed for their mules and a few head of livestock more cheaply than they can buy it, particularly if account is taken of the impact on the price of cotton of concentrating so much effort on its production.

For some readers a distinction may need to be pointed out between the principle of specialization and the principle of comparative advantage. The first is included in the second. The principle of specialization applied to areas states that *each area or location tends to produce only a few things and to sell its surplus of these and with the proceeds therefrom buy the other things needed.* We want to know more than this, however. We want to know *what things will be produced* and *what things will be bought.* It is the principle of comparative advantage that covers this.

Finally, the principle of comparative advantage is sometimes referred to as a *principle of comparative cost.* Strictly speaking, comparative advantage and comparative cost are merely reciprocals of each other — the greater the advantage, the lower the cost; the less the advantage, the greater the cost. But the term "cost" means so many different things to different people that its use in this connection often misleads. One must always bear in mind that *if a product is really produced in an area where it has comparative advantage, its money costs per unit of product will be the same there as in the other areas producing it,* ***if the rent of land is included,*** *and except for differences in costs of transportation to market.* (As pointed out earlier, the areas farthest from market will have the lowest prices and lowest money costs.) If an accurate comparison showed one area to have lower money costs than another, *this would mean that prices, wages, rents and other cost-rates were out of adjustment with each other at the time,* or *that the farmers had not yet adjusted their farming to some recent economic or other changes.* Maladjustments of this kind are extremely common, as we shall note in a later chapter. The areas which have the lowest costs in such analyses may be the ones with the highest ratios of advantage, but roughly half the time they are not. *Comparative cost must really be understood in terms of real costs,* that is, hours of man and horse labor, pounds of feed and fertilizer, machines used up, and the like. But the only way to combine these in one figure is on a dollar basis, and this leads to expressing them in money terms, and thus to endless confusion.

INTERREGIONAL COMPETITION

The different areas which are thus potential contributors to the supply of a product for a consuming center can be said to be in compe-

tition with each other. The quantity which the consuming center takes of this product at the equilibrium price is proportioned among these competing areas according to the ratios of advantage of this product in these areas.

Farmers are generally highly aware of the competition between their products and those of other areas. The potato growers of Maine know that Idaho potatoes are invading their markets increasingly. The dairy farmers of Pennsylvania, Maryland, and Virginia know that Midwest dairymen are supplying more and more of the fresh cream consumed in their city markets. Data are regularly assembled which show the changing origin of the receipts in different markets. Few attempts have been made, however, to determine what amounts of a product the different competing areas can most advantageously contribute to a market. The most ambitious effort along these lines has had to do with the production of dairy products, and more especially cream, for New England cities, for the period 1936 until the war.[4] Chart 56 shows the relative quantities of milk which each of the five competing areas stood ready to supply, allowing the necessary time for readjustments, and assuming no changes in conditions affecting production, (a) at prevailing prices, (b) at prices 15 or 20 per cent above this level, and (c) at prices 15 or 20 per cent below this level. The levels of price, of course, differ widely among these areas because they are at different distances from the consuming cities. The object of the study was to find out how the various areas would share the New England markets at different levels of price above and below those then prevailing. The curves in the chart are what are called *supply curves* in the elementary textbooks in economics. It appears that all the areas would expand their production, if prevailing prices continued, by as much as 15 per cent in the Michigan area, and by as little as 10 per cent in the Wisconsin area. The Michigan area represented in Chart 56 is in the center of the state and has relatively light soils. It had been expanding its dairying rapidly, as a result of growing more corn for silage, and after 1920, more and more alfalfa. The Wisconsin area is in Barron County, discussed in Chapter X. Dairying had been expanded there in recent years by buying concentrates instead of increasing feed production, and many farms had suffered financial reverses. The Minnesota area is in the southeastern part of the state, near the Iowa line. It had been expanding its dairy production gradually. The Vermont area is one well to the north, on the Central Plateau of Vermont. Farms were still being abandoned in the hills when

[4] It was really made as if for the period 1936–1946, but of course it did not anticipate wartime conditions.

the survey was made, but enough more cows were being kept in the valley and on less sloping land to offset and a little more the decline in number of farms. The southern New England territory included has been keeping up its production by buying more concentrates and even hay, and buying its replacements.

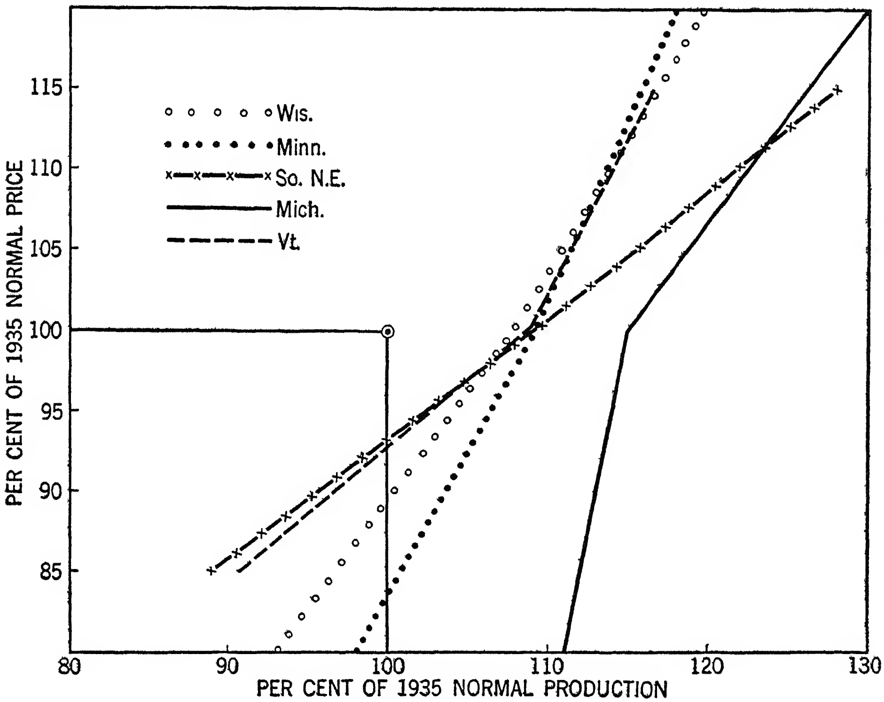

CHART 56. Supply curves for milk for five areas competing for the New England markets, for the period 1936–1946, assuming no changes in the conditions of production. (Based on data in U.S.D.A. Tech. Bulls. 709, 750, 789, and 812, and in Michigan Special Bull. 309. These bulletins analyze "Supply responses in milk production" in two New England areas, two in Wisconsin, one in Minnesota, and two in Michigan.)

It would appear that production is least affected by changes in the price of milk in the Minnesota and Wisconsin areas. Producing milk is mainly a way of marketing the feed produced on the farms of these areas. Southern New England, as one would expect, is highly price-sensitive. Vermont will reduce its production considerably if milk prices decline, and expand it with a price rise about like the Wisconsin and Michigan areas. The Michigan area apparently can help itself by expanding dairy production even though milk prices decline.

For a complete study of interregional competition, one would of course also need a demand curve showing the quantities of milk and especially cream that the cities of New England stood ready to take at various prices. It would then be possible to say not only how the competing areas would share the market at different prices, but the amount that would be produced and sold and how it would be divided among the areas.

TYPE-OF-FARMING AREAS

We made much use of type-of-farming areas in Chapters VIII to XV. We know by this time that these are segments of agriculture within which one system of farming, like cotton farming, potato farming, cotton-tobacco farming, or dairy-tobacco farming is dominant, or in the less usual situation, where two or more systems of farming are interwoven into a pattern, like market-milk production and truck growing around many cities, or cash-grain and corn-and-hogs in many parts of the Midwest. We are in a position now to consider more carefully the nature of a type-of-farming area.

The first question to raise is what determines the boundaries of such an area. It is a simple matter to draw a boundary line around an area like the Inner Blue Grass section of Kentucky or the sugar-cane area of Louisiana. Where topography or soils break sharply, so do the types of farming. Clear examples of this are the breaks between irrigated farming and dry farming in the Western states, and the dividing line between the alluvial river-bottom lands of the lower Mississippi and the broken uplands on either side. A sharp break appears in the prevailing types of farming between the corn-and-wheat farming of eastern Nebraska and the ranching of the Nebraska Sandhills.

But more often the systems of farming change slowly, with twilight zones between them. We have already noted that westward from the Red River Valley, first comes an area with little corn and a good deal of oats and barley, then an area in which wheat becomes the dominant small grain. In such territory, boundary lines have to be drawn more or less arbitrarily. In the type-of-farming survey in the census of 1929, Elliott had to decide the particular percentage of general farms which marked the western boundary of Area 174 in eastern North Dakota and the beginning of Area 172. The average percentage of general farms in the first area is 28, and in the second 18; of cash-grain farms in the first area, 45, and in the second, 76.

But Elliott also paid careful attention to changes in topography and

soils, for he realized that these persist and tend to differentiate type-of-farming areas indefinitely. The farming may be about the same in adjoining topographic zones in some periods, but not over a century. For example, it may be about the same now on the bottom lands of the Mississippi and on the adjoining uplands. At least, the farmers in both are depending on cotton as their principal source of income. But over the years, the bottom lands and uplands are likely to follow different trends. The introduction of the cotton picker and mechanized cotton farming generally is likely to produce very different effects on the bottom lands than on the uplands.

Another way of marking off type-of-farming areas is, therefore, to put within *any one boundary that territory which has had the same pattern of change*. In northern New England, for example, the territory can be divided between that in which dairying has been increasing and that in which dairying has been decreasing. These differences in trends are closely related to physical differences in most cases. Noting the differences in trends therefore often proves to be the simplest way of discovering what physical differences are significant.

Changes in types of farming caused by changes in markets and demand — such as might be caused by the growth of a city and the expansion of its milkshed and truck-growing areas — are not so easy to handle. There is really no escape from changing the boundaries of such areas whenever the market forces produce shifts in type of farming.

Another major question is the degree of detail required in the mapping. The smaller the areas, the more alike the farms will be within each. I. G. Davis mapped Connecticut into areas averaging only five or six square miles, or 25 to 30 farms.[5] Elliott's map of the United States, as already indicated, singled out 514 areas plus several hundred sub-areas. The Land Grant Colleges have generally mapped the type-of-farming areas in their states in about the same detail as did Elliott, as we have already noted in the case of Texas.[6] The boundary lines of the areas may differ, however, because of following different principles of classification. To illustrate, Utah has been divided into the four following major areas: [7] diversified-irrigation farming, specialized dry-land

[5] Connecticut Bull. 213, 1936. [6] See Ch. XIII.

[7] **Types of Farming in Utah* by Marion Clawson, Walter U. Fuhriman, George T. Blanch, and W. Preston Thomas, Utah Bull. 275, 1936.

Other examples of such studies are as follows: **Types of Farming in Illinois: An Analysis of Differences by Areas* by H. C. M. Case and K. H. Myers, Illinois Bull. 403, 1934.

**Types of Farming in Montana* by Neil Johnson and M. H. Saunderson, Montana Bull 328, 1936.

**Types of Farming in Kentucky* by Bruce Poundstone and Walter J. Roth, Kentucky Bull. 357, 1935.

**Types of Farming in Iowa* by C. L. Holmes, Iowa Bull. 256, 1929.

wheat farming, diversified-irrigation farming and ranching, and specialized livestock ranching. Then each of these major areas is subdivided, specialized livestock ranching, for example, into year-long grazing, seasonal grazing, and winter feeding. In 1935, the United States Department of Agriculture released its map called *Regionalized Types of Farming in the United States*, which shows about a hundred separate areas, consolidated from the 514 in the Elliott map.

The Davis map of Connecticut separates out the small local variations that are particularly prevalent in regions like New England, with sharp differences between valleys and adjoining uplands and between rough stony woodland and adjacent tracts of mixed crop-and-pasture farming; and between tracts of sandy outwash plain and adjacent ground moraine. Such mapping can mark off small part-time farming areas near cities, and small poultry areas following a road and sandy river valley leading to a city. With such mapping, very few of the areas need to be combinations of two or three systems of farming. If the areas are as large as Elliott's, such local variations must be glossed over under some such general description as "mixed dairy and woodland farming."

How much detail to include in type-of-farming mapping depends upon the uses to be made of the results. The Elliott mapping was intended to serve as a basis for programs of production adjustment. It was hoped that facts would be assembled as to agricultural production and trends area by area, and also that data would be collected for representative farms in these areas that would make possible the kind of budget analyses that are outlined in this book, and that from some such analyses, the types of adjustments needed to fit developing changes in demand, prices, and technology could be anticipated. The states did their mapping with similar objectives. This program, however, has been carried through as originally conceived only in part. Instead, the AAA set up production quotas which determined the adjustments to be made. The planning of the quotas, however, and the later conservation measures and payments, was based to a considerable extent on the type-of-farming mapping that had been done. This was even more true of the postwar agricultural planning done in 1944–1945. England and Wales have recently been divided into about seventy type-of-farming areas.

Also within the past few years, a number of the states, mostly in collaboration with the B A E, have developed index numbers of gross value of product, expenditures, and net income, and in some cases of physical volume of production and of expenditures, to fit directly the type-of-farming areas in their states, or representative major types of farms within these areas.

FURTHER READING

John D. Black, *Introduction to Production Economics*, New York, Henry Holt and Company, 1926, Chaps. 5, 9.

John D. Black and Albert G. Black, *Production Organization*, New York, Henry Holt and Company, 1929, Chaps. 8, 12.

*O. E. Baker and A. B. Genung, *A Graphic Summary of Farm Crops*, U.S.D.A. Misc. Pub. 267, 1938.

F. F. Elliott, *Types of Farming in the United States*, 1930 Census Monograph.

EXERCISES

1. What physical, biological, and economic factors account for the production of the leading farm products in your area?
2. What are the major competing areas for each of these products? In which competing areas is output increasing the most? Why? If output is decreasing in any, state why.
3. Find or construct a map showing the price pattern for a major commodity in your area, both around the local market and nearest large central market. Describe the influences responsible for the shape of this pattern.
4. Where are the farm products in your area processed? Explain why.
5. Show how prices and costs are related in the market area for one of your area's principal products.

CHAPTER XVII

The Combination of Productive Agents

THE SECOND LARGE SECTOR OF THE BODY OF PRINCIPLES INTRODUCED in terms of systems of farming in PART TWO has to do with making the best combination of the productive agents, land, buildings, man labor, animal labor, tractor power, machines, feed, fertilizer, and other supplies. Such a combination must take account, first, of the proportions in which the productive agents are combined; second, of large and important differences among the individual producing units, that is, among different farmers, farms, farm laborers, horses, cows, tractors, and other machines, feeds, seeds, fertilizers, and other supplies; and finally, of what types of productive agents to use, manpower or machine power, horsepower or machine power, binders or combines, Guernseys or Holsteins, etc. The usual discussion of combination of the factors of production contents itself largely with the first of these, seeming to assume all land is alike and all labor. Economists recognize differences in land when they get to discussing rents and distribution, but pay scant attention to them when dealing with production; and similarly for wages and labor. This chapter will devote itself to the first of these forms of combination, and the one following to the two others.

THE USE-RATES OF INPUT FACTORS

The foundation for the first of these forms which the problem of combination of the productive agents takes is well laid in Chapters VII and VIII in the analysis of the rates of use of fertilizer in growing potatoes and tobacco; and in Chapters IX to XII in the analysis of the rates of use of feed with dairy cows, hogs, and beef cattle. Let us begin by reviewing what we have learned in these chapters and generalizing it somewhat.

The input-output relation in the case of fertilizer applied to land takes the form of a curve of total output increasing at a diminishing rate until no further increases occur, and after that a decreasing output because the fertilizer burns the plants. From this curve can be derived

a curve of increasing and then decreasing marginal or additional outputs, shown in Chart 23 in Chapter VII, and also, not shown in Chart 23, a curve of increasing and decreasing average returns. This curve is obtained simply by dividing total outputs by total inputs at each point on the curve. The point of highest average outputs comes later than that of highest marginal returns because the marginal returns from the first few inputs of fertilizer applied to very poor land are small. They may induce more or less plant growth, but the seed or tuber output will be small. As we shall see later, if fertilizer is applied to land already fairly well supplied with plant nutrients, the curves of marginal and average returns will decline from the start.

This set of input-output relations and accompanying curves applies in essence to all input-output relations. But the shapes of the curves vary greatly depending upon the *nature of the inputs and outputs* and the *character of the fixed factor*, which is land in the case of fertilizer. If the land is pasture land and the product is simply foliage for grazing, marginal returns may begin to decrease almost from the start. If the fixed factor is irrigation land, and water is applied, very light applications will all be evaporated and not reach the plants at all, and too large applications will "drown" the plants by shutting off their supply of air. Additional cultivations may finally aerate and dry out the soil too much.

In the case of feed and livestock, the output comes from the excess over maintenance, and a distinction must be made between meat animals and those furnishing milk, eggs, or wool in addition. The maintenance part of the ration is a kind of overhead expense. If it is fed less than a maintenance ration, a meat animal returns a negative output, and beyond that point a gain in weight proportional to the excess over maintenance. The gain is greater for young animals which are mostly adding bone and muscle than for older animals mostly adding fat. These really are two different products. A dairy-type cow has milk as a third product. She will produce a positive milk output and negative meat output at the same time whenever fed less than enough for both. An egg-laying type of hen may likewise lose weight during her laying periods. The marginal and additional curves for milk or egg output take a special form because of these cirumstances, as indicated for milk in Chart 34 in Chapter IX. The shapes of the average curves are of course also affected.

Under actual farming conditions, another type of maintenance or overhead is involved on livestock farms, namely the maintenance of the breeding herd, as indicated in Tables 26 and 29 in Chapter XII. However, on beef cattle and dairy farms especially, the producing of

young animals for herd replacements may be done mainly on part of the farms, and the fattening and milk producing largely on others.

Maintenance as well as production inputs are involved in many other input-output relations. Thus, all work animals have maintenance and work rations, and a tractor uses up part of its fuel inputs merely in propelling itself; the more plows it pulls, the less the fixed input per plow, until the speed of the tractor is slowed too much. The overhead of building depreciation is about as much when the building is idle as when it is in use. Taxes, insurance, and interest on the investment are roughly the same in either case. Farm machines depreciate more rapidly with use, but still the overhead items are a large part of the total. The machine cost of a corn picker that picks 1,000 acres of corn in 4 years will be much lower per acre than one that picks the same number of acres in 10 years.

With machines, an additional item in overhead, frequently of much importance, is obsolescence. Farmers often discard machines long before they are worn out because they want to take advantage of the improvements in the new machines.

FIXED VERSUS VARIABLE COSTS

The foregoing is by way of review and further application of principles presented in Chapters VII to XII. A step in advance is to develop more fully the distinction between *fixed* and *variable* inputs. The fixed inputs are the overhead or maintenance inputs which we have been discussing, and the variable inputs are the production inputs which we have been discussing. What we are mainly doing, therefore, is shifting our terminology so that it will be more in keeping with that in the business world. For inputs, we shall also, for the same reason, use the term *costs*, which can be expressed either in physical or in money units. We shall therefore be speaking from this point on of *fixed* and *variable costs*, the first being those which are the same whether much or little is produced, and often if nothing is produced, and the second being those which increase with the output, often more or less in proportion to it. Variable costs are also sometimes called *prime* costs. The principal forms of fixed cost are interest, taxes, insurance, obsolescence, part of upkeep and depreciation, the part of feed of livestock that goes into maintenance, and of course the labor that goes with these parts of upkeep and of the feeding and care of livestock. The usual types of variable costs are fertilizer, seed, the part of feed that goes into production, the parts of upkeep and depreciation that vary with output, and the labor that goes into production.

On a family farm, much of the labor is more or less a fixed input. Only to the extent that such labor puts forth a larger effort to obtain a larger income, is it a variable input. Even farm labor hired by the year on such farms is a fixed cost in large measure.

Land costs are usually considered fixed costs. We have treated them as such in our analysis thus far. Strictly speaking, part of them are fixed and part are variable. Those which Ricardo designated as "the indestructible properties of the soil" are certainly fixed, but those which involve using up the reserves of plant nutrients in the soil vary with the yield. A 50-bushel crop of corn obtained from an acre of Marshall silt loam in Iowa consumes much more of the natural reserves of plant nutrients in that soil than does a 30-bushel crop. No satisfactory way has been devised, however, of separating these two parts of land costs, and accordingly the accepted practice is to consider all of them as fixed.

The variable costs involved in land use may vary according to yield, or according to area, or according to some combination of the two. Those connected with fitting the land for a crop are proportional to area, except that the yield may vary somewhat according to how well the land is fitted. Such harvesting costs as threshing and picking potatoes are proportional to the yield because they are ordinarily paid on a piece-rate basis. When harvesting labor is paid on a time basis, however, ordinarily the costs will not be strictly proportional to yield because more time is spent per bushel harvesting a poor crop of potatoes or apples than a good one. Piece rates also tend somewhat to reflect the yield and quality of the crop. Machine costs of harvesting are mostly proportional to area, but they increase somewhat with yields.

The distinction between fixed and variable costs is particularly important, of course, only in the very short run. If the period considered is long enough for a machine to wear out, its costs are in effect variable, since expenditures upon them can be varied when they are bought. Once the investment is made, however, the costs are fixed and can be changed only a little. Building costs are mostly variable only over a longer period than machine costs.

AVERAGE VERSUS MARGINAL COSTS

Obviously enough, a farmer has to meet his fixed costs as well as his variable costs. If his land, buildings, and machines were given him free of charge, or if somehow his horses and his cows could maintain themselves without having to use any of his valuable feed, his only concern would be with getting as large a return as possible from his variable

inputs. Once there was "free" land in this country — free except for the sometimes great difficulty of obtaining access to it. But it was no longer free once a farmer had invested some labor and money in clearing or breaking it. The costs which must be taken account of in determining the best combination of the agents of production therefore include the fixed as well as the variable items. Some way must be found of combining these. This way must be in terms of dollars and cents. Labor,

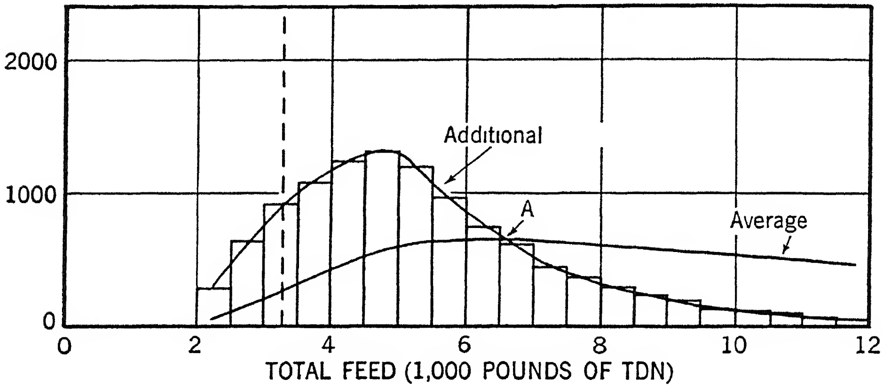

CHART 57. Additional and average milk outputs per 500 pounds T D N. (From Chart 35, Chapter IX, and Table 40.)

rent, feed, gasoline, and taxes cannot all be expressed in pounds or in any other physical measure. Also, as we shall see clearly in what follows, costs must also be expressed in average terms rather than marginal terms whenever several fixed and variable costs are to be combined. We therefore need as our next step to clarify our thinking about average costs as distinguished from marginal costs.

FEEDING DAIRY COWS This will be easiest to do in terms of some of the input-output relations that we have already analyzed. Take first the feeding of dairy cows in the Los Angeles milkshed. Chart 57 presents the same curve of additional or marginal outputs that was shown in the lower section of Chart 35 of Chapter IX, and in addition a new curve showing the average output per 500 T D N pounds of feed input. The data for these curves are given in Table 40 following. The average milk output per 500 T D N pounds of feed is calculated simply by dividing total output in each case by total feed input. The additional outputs per additional 500 T D N pounds of feed are obtained by simple subtraction. They fit the midpoints of the rectangles in each case. Data for intermediate points will have to be read from the chart. The marginal

curve, it will be noted, rises until about 4,500 T D N pounds are fed and the average outputs to around 6,250 pounds. This highest point on the curve of average outputs, designated by A, is exactly under Point L in Chart 35 in Chapter IX. It is the point where the most milk is produced per pound of feed, for the reasons already indicated — at this point none of the feed goes into producing flesh and fat, and the maintenance ration is spread over the largest possible milk output before gain in weight sets in.

It will be noticed that the curve of average output crosses the curve of marginal output at Point A. This is a necessary condition. As long as the marginal curve is above the average curve, more feed input will raise the average; but when the marginal curve has once fallen below

TABLE 40. ADDITIONAL AND AVERAGE OUTPUTS FROM 500 POUNDS T D N; AND ADDITIONAL FEED INPUTS PER 100 POUNDS OF MILK

Total feed inputs per cow (pounds T D N)	*Total milk output (pounds)*	*Additional output from 500 T D N pounds of additional feed input*	*Average milk output per 500 T D N pounds of feed input*	*Additional feed input per 100 pounds additional milk output*	*Average feed input per 100 pounds of milk*
(1)	(2)	(3)	(4)	(5)	(6)
2,250	300	300	65	167	750
2,750	925	625	170	80	297
3,250	1,825	900	280	55	178
3,750	2,900	1,075	385	47	129
4,250	4,125	1,225	485	41	103
4,750	5,400	1,275	570	39	88
5,250	6,570	1,170	625	43	80
5,750	7,520	950	655	53	76
6,250	8,300	780	665	64	75
6,750	8,925	625	660	80	76
7,250	9,410	485	650	103	77
7,750	9,785	375	630	133	79
8,250	10,085	300	610	167	82
8,750	10,335	250	590	200	84
9,250	10,535	200	570	250	88
9,750	10,690	155	550	323	91
10,250	10,815	125	530	400	95
10,750	10,915	100	510	500	98
11,250	10,995	80	490	625	102
11,750	11,060	65	470	770	106
12,250	11,110	55	450	910	110

the average, more feed will lower the average. The two curves can, therefore, cross only at the peak of the average curve.[1]

To express these data in the form of costs, however, we need to figure them the other way around, to obtain *inputs per unit of output* instead of outputs per unit of input. This is accomplished simply by dividing feed inputs by the milk outputs, with the results appearing in the last two columns of Table 40 and in Chart 58. These curves also cross at Point A; they must because they are merely reciprocals of the curves in Chart 57. The average curve rises slowly beyond A — it is weighted down with all the inputs that have gone before.

FERTILIZER AND POTATOES AND TOBACCO The behavior of average and marginal costs in the use of fertilizer on potatoes and tobacco may be equally instructive. Converting the total returns of Chart 23 in Chapter VII to average outputs per hundredweight of fertilizer, as in the third column of Table 41, and the curve of additional outputs to a unit basis, as in the fifth column, appears to locate Point A at the first application of fertilizer, very much earlier than in the feeding of dairy cows. In the last two columns of the table, these outputs per unit of input are converted to their reciprocals. The average amount of fertilizer used per bushel of potatoes rose from 2.2 pounds with 5 hundredweight to 7.1 with 30 hundredweight. It took 29.4 pounds of fertilizer per bushel to bring forth the last 17 bushels of additional output.

TABLE 41. AVERAGE AND MARGINAL OUTPUTS AND INPUTS IN THE APPLICATION OF FERTILIZER TO POTATOES

Inputs of fertilizer (cwt.)	*Outputs of potatoes (bu.)*	*Average output per cwt. of fertilizer (bu.)*	*Additional outputs*	*Additional output per unit of additional input*	*Fertilizer per bushel of potatoes*	
					Average (lbs.)	*Additional (lbs.)*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5	226	45.2			2 2	
10	297	29.7	71	14.2	3.4	7.0
15	346	23.1	49	9.8	4.3	10.2
20	380	19.4	34	6.8	5.3	14.7
25	404	16.2	24	4.8	6.2	20 8
30	421	14.0	17	3.4	7.1	29.4

[1] The Point A on the average curve, which is vertically under Point L on the total curve, can also be located by drawing a line through the point of origin of the total curve, zero on both axes, tangent to the curve of total milk production.

Something more needs to be said about the location of Point A in this instance. One cannot be sure where it would appear if a full curve were available. It might come somewhere within the first application

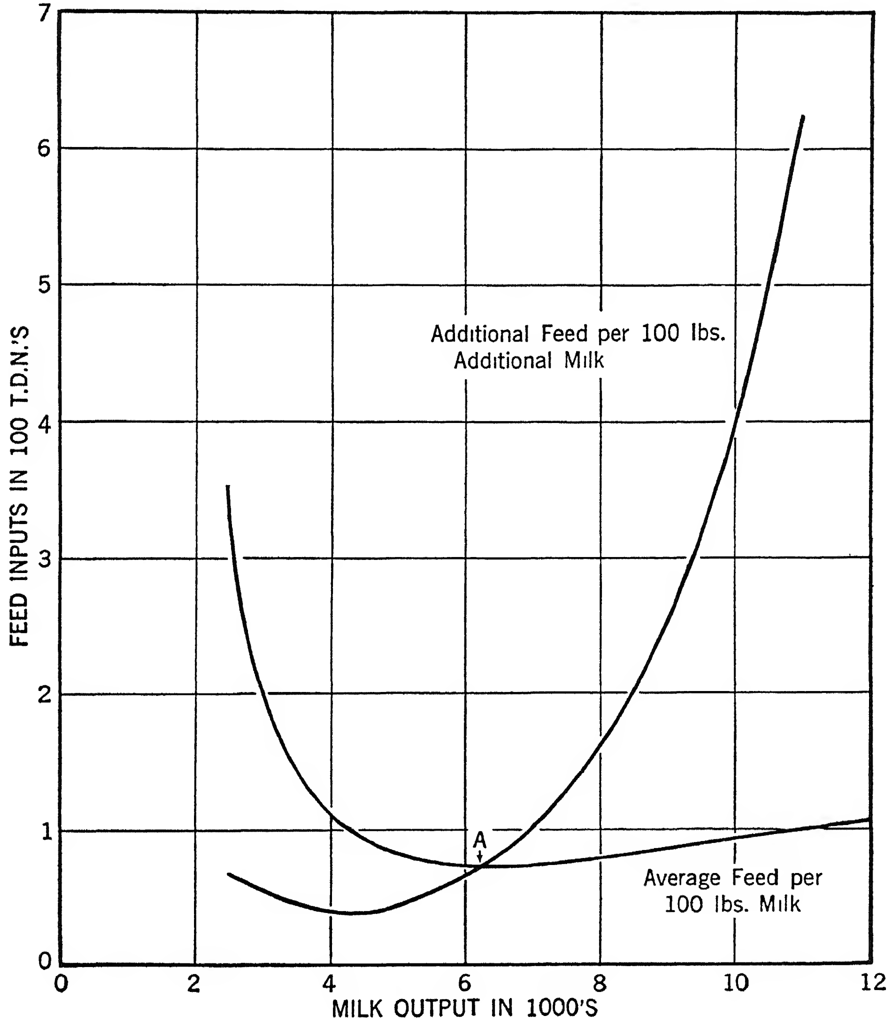

CHART 58. Additional and average feed inputs per 100 T D N pounds. (Data in Table 40)

of 500 pounds, but probably it would come still earlier. We must remember that the commercial fertilizer applied is in addition to the plant nutrients already in the soil. To get data comparable with feed and milk production, one must measure the plant nutrients already in the

soil and add the commercial fertilizer to this. Even after the land in Aroostook Farm was cropped five years without fertilizer, it yielded 123 bushels of potatoes with no fertilizer application. Only by using almost sterile soils, as in experimental work with plants in pots, is it ordinarily possible to locate Point A in fertilizer trials. When fertilizers are applied to Prairie soils still high in humus, frequently only very slight additional

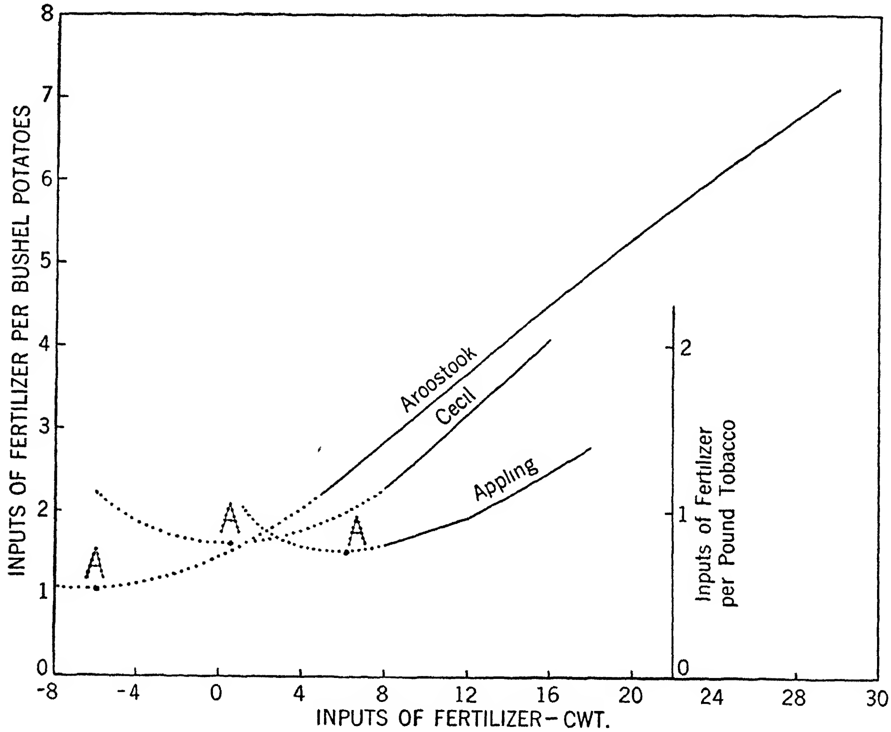

CHART 59. Curves of average fertilizer inputs per unit of output, for potatoes at Aroostook Farm, and for tobacco on Cecil and Appling soils in North Carolina, the outputs being expressed as percentages of the output for 800 pounds of fertilizer. (Based on data in Tables 41 and 42.)

outputs are obtained — in other words, only a piece of the tail end of the average and marginal curves is discovered. Considerably more of it will appear in fertilizer trials on sandy soils in New England and the South.

Table 42 shows the average and marginal fertilizer inputs in producing tobacco on the two North Carolina soils considered in Chapter VIII. The average inputs rise more rapidly on the Cecil than on the Appling soils. Chart 59 presents curves, comparable to the average curve of Chart 58, for these two applications of fertilizer and for the potato trials,

with suggestion of the probable location of Point A for each, on the dotted-line extensions. The farther beyond Point A an application of fertilizer is, the more rapid the rate of increase in average cost. Apparently the first application of fertilizer to the Appling soils was only a little beyond Point A and the same application to the Cecil soils was well beyond it, and the application on the Aroostook Farm still further beyond A. (The implication of the − 8 is that the soil would need to contain this amount less of plant nutrients to show Point A.)

TABLE 42. AVERAGE AND MARGINAL INPUTS IN THE APPLICATION OF FERTILIZER TO TOBACCO ON TWO DIFFERENT SOILS

Inputs of fertilizer per acre	*Cecil soils Fertilizer per pound of tobacco*		*Appling soils Fertilizer per pound of tobacco*	
	Average (lbs.)	*Marginal (lbs.)*	*Average (lbs.)*	*Marginal (lbs.)*
800	1.14		.81	
1,000	1.35	5.00	.88	1.33
1,200	1.58	10.00	.97	2.00
1,400	1.82	20.00	1.09	5.00
1,600	2.06	40.00	1.23	12.50
1,800			1 38	40.00

FIXED AND VARIABLE COSTS COMBINED

The marginal and average costs which we have just been considering are for a single input factor, feed or fertilizer, when used with a set of other factors taken as fixed. The cows, barns, and equipment were assumed to be fixed, and even the labor of caring for the cows; similarly the land, equipment, seed, sprays, and planting, cultivating, and harvesting operations on the potato and tobacco farms. The answers given by the curves in Charts 58 and 59 would be the final answers if the sole purpose were to economize in the use of feed and fertilizer. The other variable input factors each have curves of marginal and average returns much like the ones for feed and fertilizer. Their Point A's, however, are likely to come either before or after, and the slopes of the curves to be different. The average and marginal curves for fixed factors, of course, decline all the way, or at least until their capacity is reached. If we want a Point A for all the input curves combined, obviously we

must add together the average inputs for all the variable and fixed factors. These give us the point of *least-cost combination,* sometimes referred to hereafter as LC.

LOS ANGELES DAIRY FARM Such an analysis is presented for milk production in the Los Angeles milkshed, per cow in Table 43, and per hundredweight of milk in Table 44. The quantity of feed is increased per cow in order to obtain a greater output of milk, and so also is the proportion of concentrate in the ration. At the three lowest milk outputs, only alfalfa is fed. The quantity of alfalfa decreases with the higher milk outputs, because a cow must eat a lot of grain in order to get the necessary feed inputs for these. The cost of feed per 100 pounds T D N therefore rises as the feed input increases. Labor cost increases as more milk is obtained, because more time is required in milking, in handling the extra milk, and in handling the extra feed. Likewise, the cost of hauling the milk rises. With the heavier feed intake, the dairy cows must be replaced more rapidly, because digestive and other difficulties occur more frequently. Total costs per cow more than double as milk output increases from 6,500 to 11,000 pounds. The by-product credit is income from the sale of calves and other sources.

In Table 44, these costs have been converted to a hundredweight basis. Feed costs make up from one half to two thirds of total costs. The feed costs decline slightly as milk output rises from the lowest levels and then rise again from 7,500 pounds. Although the maintenance ration is being spread over a larger output, the ration becomes more costly with the higher outputs because it contains more concentrates. The other costs, on a hundredweight basis, decline or remain constant, except for the slight rise in replacement costs. Labor cost declines slightly. "Fixed" costs are fixed per cow, but decline per hundredweight of milk. The costs which decline with greater output, however, are relatively small, and they decline but slightly, so that they do little to offset the effect of the rising feed costs. As a result, the combined cost of all items reach their low point at 8,000 to 8,500 pounds of milk per cow, compared with 7,500 for feed alone. Chart 60 shows the curves for feed, labor, fixed costs, and all costs combined, and the Point LC of least-cost combination.

The least-cost point, however, is not usually the point at which profits are greatest. Profits are based on the difference between costs and selling prices, and must also take account of the volume of output. They are based upon profit per pound of milk multiplied by the number of pounds. In Table 45, profits have been calculated per cow, assuming that the

TABLE 43. COSTS PER COW ACCOMPANYING VARYING RATES OF MILK PRODUCTION RESULTING FROM VARYING RATES OF FEEDING, LOS ANGELES MILKSHED, 1941

Production per cow (pounds of milk)	*Feed inputs*			*Feed cost* [a]	*Labor cost* [b]	*Milk hauling cost* [c]	*Dairy cow replacement cost* [d]	*Fixed costs* [e]	*By-product credit*	*Combined costs per cow*
	T D N pounds	*Alfalfa (pounds)*	*Concentrates (pounds)*							
6,500	5,170	10,020	0	$ 90.10	$33.70	$ 7.80	$17.00	$26 50	$ 8.30	$166.80
7,000	5,410	10,490	0	94.40	34.70	8.40	18.35	26 50	8.50	173.85
7,500	5,680	11,020	0	99.20	35.80	9.00	19.70	26.50	8.80	181.40
8,000	5,970	11,000	400	106.80	36.80	9.60	21.10	26.50	9.00	191.80
8,500	6,320	11,000	880	116.10	37.90	10.20	22.40	26.50	9.25	203.85
9,000	6,730	11,000	1,435	126.90	38.60	10.80	23.80	26.50	9.65	216.95
9,500	7,240	10,000	2,830	145.00	40.00	11.40	25.15	26.50	9.85	238.20
10,000	7,920	9,000	4,460	167.70	41.00	12 00	26.50	26.50	10.00	263.70
10,500	8,890	8,000	6,480	198.10	42.10	12.60	27.85	26.50	10.50	296.65
11,000	10,670	7,000	9,730	252.30	43.20	13 20	29.25	26.50	11.65	352.80

[a] Same feeds and prices as in Table 14, Chapter IX; the same composition of the concentrate ration throughout.
[b] One half of the labor is assumed to be fixed and the other half to vary with the output. Wages and labor as in the Operating Statement in Chapter IX. The basic rate assumed per cow was $40 at 9,500 pounds output.
[c] At 12 cents per hundredweight.
[d] Replacements at the rate given in Chapter IX, 35 cows bought, 30 sold, and 5 died, when the cows were producing 10,000 pounds of milk. For 6,500 pounds output, the replacement rate assumed was 20 cows bought, 15 sold, 5 died. The replacement cost is taken as proportional to milk output between these points.
[e] Includes depreciation and upkeep of buildings and machinery, insurance, property taxes, and interest, including interest on the investment.

TABLE 44. COST PER HUNDREDWEIGHT OF MILK FOR VARYING RATES OF MILK PRODUCTION RESULTING FROM VARYING RATES OF FEEDING, LOS ANGELES MILKSHED, 1941

Production per cow (pounds)	*Feed cost*	*Labor cost*	*Milk hauling cost*	*Dairy cow replacement cost*	*Fixed costs*	*By-product credit*	*Combined costs*
6,500	$1.386	$.518	$.120	$.261	$.407	$.127	$2.566
7,000	1.348	.495	.120	.262	.378	.121	2.483
7,500	1.322	.477	.120	.262	.353	.117	2.418
8,000	1.335	.460	.120	.263	.331	.112	2.397
8,500	1.365	.445	.120	.263	.311	.108	2.398
9,000	1.410	.428	.120	.264	.294	.107	2.410
9,500	1.526	.421	.120	.264	.278	.103	2.507
10,000	1.677	.410	.120	.265	.265	.100	2.637
10,500	1.886	.400	.120	.265	.252	.100	2.825
11,000	2.293	.392	.120	.265	.240	.105	3 207

dairyman is going to keep his number of cows constant, and at four levels of prices.

A loss is incurred at every level of output when milk prices are \$2.00 per hundredweight, but losses are least at around 7,500 pounds. With milk at \$2.50 per hundredweight, the highest profit is at around 8,500

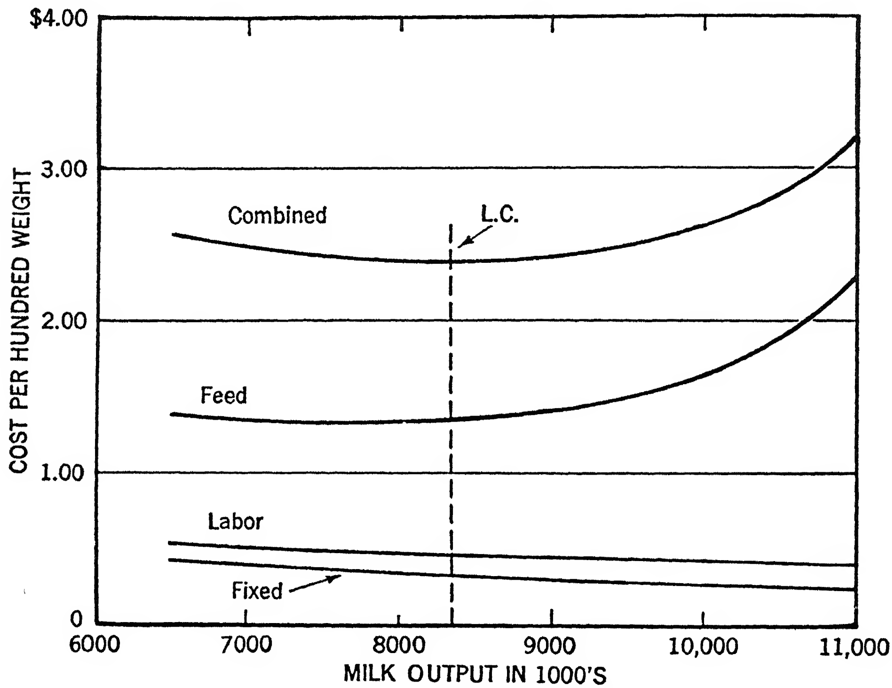

CHART 60. Feed costs, labor costs, fixed costs, and combined costs per hundredweight of milk with varying outputs resulting from varying rates of feeding. (Combined-cost curve includes all the costs given in Table 44.)

pounds; with milk at \$3.00 and at \$3.50 per hundredweight, it is somewhere near 9,000 pounds. More refined calculations would show the outputs more exactly. These are the points of *highest-profit combination*, hereafter designated as HP. They are, of course, the points where the last units of the varying factors just pay for themselves. Only when the analysis has been carried to this stage has the final answer been reached as to the most profitable rate of feeding.

It will be remembered that the cows in the eighty-one herds surveyed in the Los Angeles milkshed in 1939 were averaging 9,800 pounds of milk. Prices were running only a little over \$3.00 per hundredweight. This suggests that these herds were being fed beyond the point of highest-

profit combination. This high output of 9,800 pounds was obtained, however, by replacing many of the cows before the end of their lactation periods. The input-output curves which were used in Chapter IX, and again here, are those of the Jensen-Woodward trials which kept the cows through full lactation periods. The Los Angeles dairymen probably have been feeding their cows well up to the highest-profit point, probably more of them below than above. The wide range in feed inputs which they exhibit is mainly due to differences in replacement rates.

TABLE 45. PROFITS PER COW AT FOUR LEVELS OF MILK PRICES, AND WITH COSTS AS SHOWN IN TABLE 44

Production per cow (pounds)	*Profit per cow at different prices per 100 pounds of milk*			
	\$2.00	*\$2.50*	*\$3.00*	*\$3.50*
6,500	\$− 37	\$− 4	\$ 28	\$61
7,000	− 34	1	36	71
7,500	− 31	6	43	81
8,000	− 32	8	48	88
8,500	− 34	9	51	94
9,000	− 37	8	53	98
9,500	− 48	− 1	47	94
10,000	− 64	− 14	36	86
10,500	− 87	− 34	18	71
11,000	− 133	− 78	− 23	32

The foregoing analysis has been worked out in terms of varying the outputs by varying the feed inputs per cow, with the other inputs changing only as required by the varying feed inputs. A parallel analysis can be worked out with the outputs varying with the rates of cow replacement, or the amounts of labor used, even by changing to three milkings daily. Full analysis requires testing out all these alternatives. Feed inputs, however, are the dominant factor in any variation in milk outputs.

AROOSTOOK TWO-MAN POTATO FARM

Table 23 and Chart 24 in Chapter VII include some of the costs that vary with the variations in fertilizer inputs on the two-man potato farm in Aroostook County. Table 46 following presents a full set of these costs. Table 47 shows these costs converted to a per-bushel basis. All of the

costs decrease per bushel except fertilizer and storage. At the 1935–1939 level of production on this farm, 340 bushels per acre, the fertilizer cost was the largest single item of expense by a wide margin. Fertilizer and storage costs, the two increasing-cost items in Table 47, made up about half of the costs. Seed, man labor, and equipment costs increase somewhat per acre with output and hence do not decline as rapidly as the entirely fixed costs.

TABLE 46. COST PER ACRE ACCOMPANYING VARYING YIELDS OF POTATOES RESULTING FROM VARYING INPUTS OF FERTILIZER ON THE TWO-MAN AROOSTOOK POTATO FARM

Yield per acre	*Fertilizer costs* [a]	*Fixed costs* [b]	*Seed costs* [c]	*Man labor costs* [d]	*Horse labor*[e] *and equipment* [f] *costs*	*Storage costs* [g]	*Other supplies* [h]	*By-product credit* [i]	*Combined costs*
100	$ 0	$14.00	$6.00	$17.20	$10.00	$0	$10.00	$+ 3.00	60.20
150	0	14.00	7.20	18.00	10.35	0	10.30	+ 2.00	61.85
200	4.30	14.00	9.60	19.10	10.60	0	10.60	+ 1.00	69.20
250	11.25	14.00	10.80	20.25	10.80	3.50	11.00	0	81.60
300	27.50	14.00	11.40	21.60	11.00	7.00	11.50	− 1.00	103.00
350	50.00	14.00	12.00	23.00	11.10	10.50	12.15	− 3.00	129.75
400	78.80	14.00	12.60	24.35	11.20	14.00	12.60	− 6.00	161.55
450	114.00	14.00	13.00	25.70	11.30	17.50	13.10	− 8.00	200.60

[a] Derived from Chart 23, Chapter VII, with adjustments to fit this particular two-man farm. The average yield on the experimental plots was 380 bushels; on this farm, 340 bushels, with an average application of 2,000 pounds of fertilizer. Also on this farm, barnyard manure was available sufficient for 5 acres of potatoes applied at a rate equivalent to 2,000 pounds of commercial fertilizer per acre. With yields of 150 bushels per acre, the barnyard manure was adequate and no commercial fertilizer was purchased. With yields of 250 bushels per acre, the barnyard manure sufficed for 15 acres; with yields at 400, for only 3.2 acres.

[b] Fixed investment in land, buildings, equipment, interest, insurance, and taxes.

[c] One half of the seed is purchased — with larger inputs of fertilizer, more seed is used.

[d] Both year-round hired labor and extra hired labor for cutting seed and picking potatoes.

[e] Only out-of-pocket costs for feed; also horseshoeing and veterinary services plus depreciation from aging.

[f] Depreciation, repairs, fuel oil, lubricating oil and grease, and servicing for all the equipment used on the farm. The increase with larger yields is due to heavier duty of the tractors and trucks, spraying equipment, etc.

[g] The cost of hiring commercial storage. This farm has limited storage capacity and will handle a crop of 200 bushels per acre only.

[h] Other supplies include clover and grass seed, spray materials, lime for the soil, materials for treating seed, barrels, and also other services such as telephone, etc. Sacks are considered part of the marketing costs along with freight and brokers' fees, and are deducted from the selling price of the potatoes to get a net farm price.

[i] By-product credit for income from other sources, less direct costs chargeable to these other sources of income. Thus, threshing costs are charged against the receipts from the sale of oats, hay, milk, eggs, etc. Also the costs of purchased dairy and poultry feeds. The yields of oats and hay are assumed to vary with the amount of fertilizer used according to Table 10 in Chapter VII. With the low yields of potatoes, not enough oats and hay were produced to feed the horses and other livestock, so that by-product credit became a positive amount and was subtracted from the other expenses.

TABLE 47. THE COSTS IN TABLE 46 EXPRESSED IN CENTS PER BUSHEL OF POTATOES

Yield per acre	*Fertilizer costs*	*Fixed costs*	*Seed costs*	*Man labor costs*	*Horse labor and equipment costs*	*Storage costs*	*Other supplies*	*By-product credit*	*Combined costs*
100	0 ¢	14.00¢	6.00¢	17.20¢	10.00¢	0 ¢	10.00¢	3.00¢	60.2¢
150	0	9.33	4.89	12.00	6.90	0	6.87	1.33	41.2
200	2.15	7.00	4.80	9.55	5.30	0	5.30	.50	34.6
250	4.50	5.60	4.32	8 10	4.32	1.40	4.64	0	32.3
300	9.17	4.67	3.80	7.20	3.67	2.33	3.83	− .33	34.3
350	14 29	4.00	3.43	6.57	3.17	3.00	3.47	− .86	37.1
400	19.70	3.50	3.15	6.09	2.80	3.50	3.15	− 1.50	40.4
450	25.33	3.11	2.89	5.71	2.51	3.89	2.91	− 1.78	44.6

The point of least-cost combination in Table 47 is slightly above 250 bushels per acre. Without the barnyard manure, it would be close to 300 bushels per acre. Thus it is definitely below the actual production of the 1935–1939 period. This potato farm was, therefore, producing beyond its least combined-cost point. Table 48 shows the highest-profit combination for this farm at four different levels of price, with the cost-rates as used in Table 46. With potatoes selling as low as 40 cents a bushel, this farm had a net return to management and labor of only 7.7 cents per bushel or $19 per acre, at 250 bushels per acre, as nearly as the point can be located from the table. At 300 bushels per acre, the net return per bushel was 5.7 cents, and this multiplied by 300 bushels equals only $17 per acre.

With potatoes selling at 50 cents a bushel, which was about the average price per bushel realized on the full 17,000 actually produced on this farm in 1935–1939, the highest-profit combination appearing in the table is $47 per acre at 300 bushels.[2] At 340 bushels per acre, therefore, this farm produced fully up to its highest-profit point. At 60 cents per bushel, the highest-profit point would be around 350 bushels; and at 80 cents, close to 450 bushels per acre. The least-cost and highest-profit combinations are farther apart on this farm than on the Los Angeles farms because the decreasing-cost items are a larger fraction of the total.

[2] The $8,740 realized from the sale of 15,400 bushels equals 51.4 cents per bushel for the full 17,000 bushels measured in the field.

TABLE 48. PROFITS PER ACRE AT FOUR LEVELS OF PRICES AND COST-RATES AS USED IN TABLE 9

Yield per acre	*Profit per acre at different prices per bushel*			
	40 cents	*50 cents*	*60 cents*	*80 cents*
100	$− 20	$− 19	$ 0	$ 20
150	− 2	12	28	58
200	11	31	51	91
250	19	43	68	118
300	17	47	77	137
350	10	45	80	150
400	− 2	38	78	158
450	− 21	24	69	

This analysis can also be worked out on the basis of outputs per acre varying with the labor inputs according to the thoroughness of the preparation of the seedbed, care in planting, numbers of cultivations and sprayings, and care in harvesting. The yields per acre with such variations in labor input would vary within a range of perhaps 50 bushels per acre. A similar but smaller variation could be produced by varying the inputs of horse labor and equipment. Of course, in actual farming operations these separate input factors do not vary independently of each other. They tend to increase or decrease together, but at different rates. All of them are free to be changed except the fixed factor, that is, the farm itself. The cropping system is assumed to be fixed also, for if this farm were to be operated according to another cropping system, the whole schedule of costs would be changed more or less.

BALANCING THE MARGINAL PROFITS OR REVENUES One final step is needed to complete the analysis of use-rates of the input factors. The dairy farmer has several alternative ways of adding to his profits or revenues at the point of highest-profit combination — by using more feed, or labor, or replacements. The potato grower can add more fertilizer, green manure, cultivations, and sprayings. For each of these there is a highest-profit combination, that is, a point where the last units of the variable factors just pay for themselves, with the other factors assumed as fixed. The last input of each of these at its highest-profit point, that is, the marginal input, adds a certain amount to the farm profits. The farmer, if he is rational and knows what he is doing, *will always choose the one which adds most to his profit.* He will thus always be balancing the

Costs on family farms are sometimes analyzed as if they were farms with hired managers, and wage rates are *imputed* to the proprietor and to the family labor.[3] In such cases, the farm products consumed by the family living must be included as another product and their value included in the column for by-product credit. Also, the value of the use of the farm dwelling must either be included as a by-product or subtracted from the fixed costs. The result will be approximately the same either way.

When wage rates are *imputed* to family and proprietor labor, any one of the following bases may be followed: (1) What it would cost to hire labor to do the same work. (2) What this proprietor and his family labor would receive as wages if they were working for another farmer or perhaps at another occupation. (3) What they could contribute to net farm income at some other use on the same farm, or at least while living at home. The rates obtained by following these bases differ widely. Following any one of them may do violence to the facts on a particular farm, especially the first one. The situations to which each is appropriate are discussed in another chapter.

Finally, it should be stated here that the manner in which the receipts and expenses are divided on share-rented farms affects very greatly the location of the highest-profit point. This subject will be developed in the chapter on "The Management of Rented Land."

FURTHER READING

John D. Black, *Introduction to Production Economics*, New York, Henry Holt and Company, 1926. Chap. 12.

John D. Black and Albert G. Black, *Production Organization*, New York, Henry Holt and Company, 1939. Chap. 6.

EXERCISES

1. Which costs are fixed and which variable on the Barron County, Wisconsin, dairy farm analyzed in Chapter XI? On the Indiana crop-and-livestock farm analyzed in Chapter XIV?
2. Construct a table of additional and average costs for a corn-and-hog farm, using the data of Chart 45 in Chapter XII for feed inputs and gains in weight.
3. Reconstruct Tables 43, 44, and 45 and Chart 60, using the same physical quantities but using prices of feed, labor, replacement cows, and milk as they have prevailed in your county or state in the past year. How much difference is made in the results in Table 45?
4. Which enterprises on your home farm are commonly pushed beyond the least-cost point? Which not? Support your answer.

[3] The rates must be imputed because none has been established for them by a process of hiring.

CHAPTER XVIII

The Combination of Productive Agents — continued

REPEATEDLY IN CHAPTERS VII TO XV HAS SOME REFERENCE BEEN MADE to differences in the productivity of different types of land or soils, or to their response to management; similarly to the varying productivity of cows and other animals and their capacity to handle feed, or different kinds of feed; and to comparable differences among farmers and farm workers. We have now reached the point where we need to analyze these differences rather carefully, for they figure largely in the economy of agricultural production.

PRODUCTIVITY DIFFERENCES

Fortunately, also, we now have the analytical tools wherewith to measure differences in productivity. If one of two acres of land yields more potatoes than the other with the same amounts of fertilizer, seed, and the other productive agents, surely it is the more productive. It produces more potatoes per unit of input. Output per unit of input is therefore one measure of productivity. The term *efficiency* is now commonly used for this measure. Also, it has become apparent that some acres of land can use more fertilizer and other input factors to good advantage than others, and this also contributes to productivity. To this measure the term *capacity* is now commonly applied. Efficiency and capacity, in fact, are referred to as the *two dimensions* of productivity,[1] capacity being measured at the Point HP of highest-profit combination. Chart 61 shows the appropriateness of this usage. When 20 hundredweight of fertilizer are applied to this acre of land, at the highest-profit Point X, the product is 300 bushels, represented by the Rectangle

[1] Dr. H. C. Taylor first used the terms "capacity" and "efficiency" in this same general sense in a paper before the American Economic Association at Columbus, Ohio, in December, 1916. See Vol. VII, No. 1, Supplement to the *American Economic Review*, March, 1917, pp. 50*ff*.

OCDX. The output per hundredweight of fertilizer at X is 15 bushels, measured by DX, and the capacity is 20 hundredweight, measured by OX. And OX × DX = OCDX. The Curve OAD is the curve of average outputs; the Curve OMB is the curve of additional outputs. At BX, the highest-profit point, the last marginal hundredweight of fertilizer applied just paid for itself.

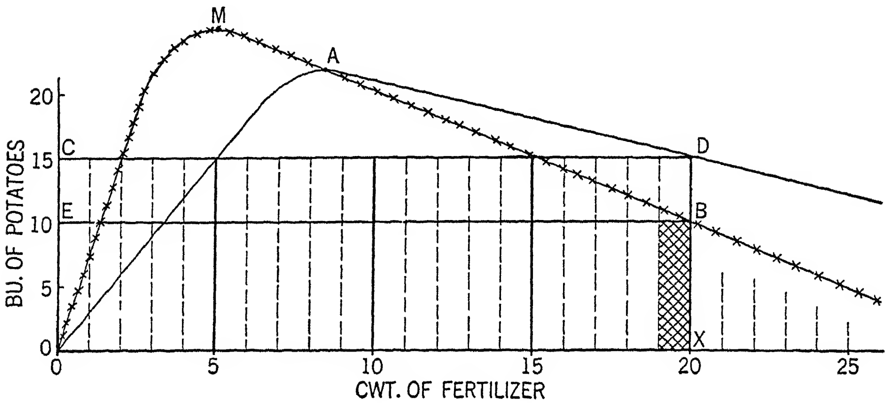

CHART 61. The two dimensions of productivity of an acre of Aroostook potato land using fertilizer in producing potatoes.

If the productivity of an acre of Michigan potato land were measured in this way, its highest-profit point might come at 8 hundredweight of fertilizer with a yield of 160 bushels. Its capacity would be 8 hundredweight, but its efficiency would be 20 bushels per hundredweight compared with 15 on the Aroostook land.

We can now go back and analyze the differing productivities of the Appling and Cecil soils of North Carolina in the growing of flue-cured tobacco. The Appling soils used 16 hundredweight of fertilizer at the HP point; the Cecil, 14 hundredweight. The output per hundredweight of the first was 81 pounds of tobacco; of the second, 57. The Appling soils, therefore, had higher capacity for fertilizer than the Cecil soils, and higher efficiency in using it.

The next step in the analysis is to divide the productivity represented by rectangle OCDX into the part contributed by the land and other fixed factors associated with it, and the part contributed by fertilizer as the variable input. The addition to the product of the last unit of fertilizer applied is indicated by the small cross-hatched rectangle. Since all the units of fertilizer are of exactly the same material, all contribute exactly the same to the product at this point. This rectangle

multiplied by 20 therefore measures the productivity of all the fertilizers applied. This is rectangle OEBX. Thus the productivity of land and associated fixed factors must be Rectangle ECDB. This rectangle is really the *net productivity* rectangle; it is *what is left after the fertilizer is paid for*. The height of this net productivity rectangle is always measured by the differences between the average and additional outputs at the point of highest-profit combination, DB in this case; the length of it, by the capacity dimension EB, or OX, in this case. The distance DX, which we have called the efficiency of the land, is really the output from land plus fertilizer per unit of fertilizer. If one wishes, one can speak of DB as measuring the *net efficiency* of the land, and BX as measuring that of the fertilizer.

Thus, we have developed a very simple method of separating the products of the fixed and the variable factors — draw the average-output and additional-output curves to the highest-profit point and construct the two rectangles.

Suppose there are several fixed factors — land, buildings, equipment — can the product of these be separated? Not so long as they are all considered as fixed factors. If other factors are fixed, and any one of these is varied, its net product is the upper rectangle.

Suppose there are two or more variable factors — fertilizer, man labor, horse labor — what then? The lower rectangle then measures the net product of *composite units of these* in the proportions in which they are combined.

In these ways, all the factors used in production can be included in the measurement; the fixed factors, those that vary with area, and those which vary with output. Capacity and efficiency can thus be measured at the point of highest profit for all costs combined, which we found was at 300 bushels with the prices for input factors prevailing in 1935–1939, and potatoes selling at 50 cents a bushel. It would be at 350 bushels with potatoes selling at 60 cents a bushel.

The capacities, efficiencies, and productivities which we are considering are thus, in the end, *economic*. They vary with prices which, in turn, vary with the supplies of the input factors available and the demand for the product. How much of any input factor is used, or how much it is economized, depends upon its price. It is possible to work out pure physical capacities and efficiencies by defining optimum capacity in physical terms, like highest average output per unit of fertilizer, but the actual combinations of the factors in practical farming are in terms of economic capacities and efficiencies. Physical input-output relations are necessary before the economic capacities and efficiencies can be

determined, but only after the physical and economic have been combined are directly usable results obtained.

Suppose the fertilizer is not used up to the point of highest-profit combination, as is frequently the case — what then becomes of the rectangles? The output added by the last unit of fertilizer applied still measures the contribution of the fertilizer. But the total rectangle is smaller than at the optimum combination, and the upper rectangle too small a part of the total. It is possible, of course, to speak of the efficiency of land in using *any* amount of fertilizer. But when the term efficiency is employed *without any qualification*, it is understood to be efficiency at the highest-profit optimum.

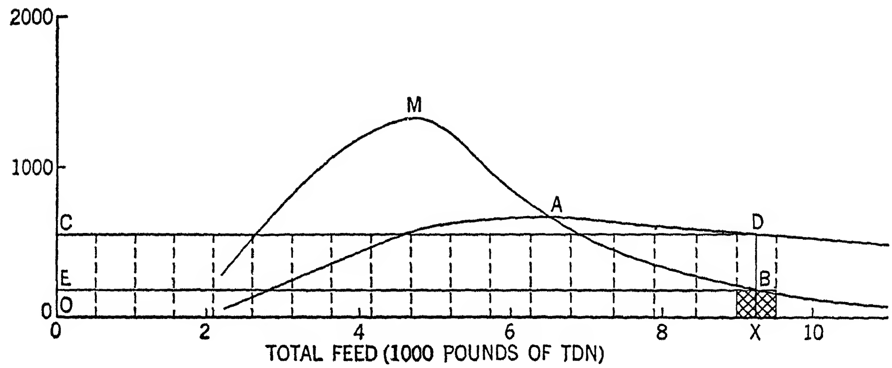

CHART 62. The dimensions of productivity of the cows in the Los Angeles milkshed represented by Chart 57 in Chapter XVII.

Let us now construct the productivity rectangles for the cows in the Los Angeles milkshed. Their capacity is at the rate of 8,200 pounds of feed per annum, and 9,800 pounds of milk, taking account of the practice of culling out a third of the cows and replacing them by fresh milkers before the end of their lactation periods, this 9,800 pounds being their highest-profit combination at 1941 prices. The upper rectangle measures the net product of the cows and the associated fixed factors listed in Table 43 in the last chapter, including half the labor; and the lower rectangle the product of the feed and other input factors that varied with the feed, including the other half of the labor. The rectangle for the cows and other fixed factors is wide because of the very high investment in cows and buildings and the expenditures upon replacements. Under more normal conditions, the cows would be fed less heavily and the upper rectangle would be relatively smaller. Even at 8,000 pounds of feed input, the upper rectangle would be very much narrower.

Obviously the size of the lower rectangle depends upon the type and quality of the input factors — feed, fertilizer, labor. But so does the size of the upper rectangle. The productivity of land or cows — or of any productive agent commonly considered as the fixed factor — therefore varies according to the type of other factors associated with it. For cows, it will be one thing for a pure roughage ration and another for a ration with much concentrate in it. It is necessary, therefore, to indicate the type of inputs used when talking of productivity and capacity and efficiency. *If this is not done, then the assumption is that types of inputs were used that enabled the land or cow to show its* largest *net productivity* rectangle at the HP point.

It also should be apparent by now that a piece of land has one combination of capacity and efficiency in the use of fertilizer, and another in the use of labor; and similarly for any other input factors — irrigation water, cattle on grass, seed, etc. A cow has separate combinations for feed, labor, shelter, management, etc.

The type of output also needs to be designated — is it milk or beef? And, if the former, is it butterfat that is wanted or market milk? If beef is wanted, is it fat or flesh and bone?

When all of these different elements are taken into account, it becomes evident that individual production units may not only have a wide range of differences in productivity, which is generally recognized, but in the combinations of capacity and efficiency which give them their varying productivities. One field may be low in both capacity for and efficiency of fertilizer use; and another high in both; and others may be high in one and low in the other. Their combinations may be very different from these in terms of labor. In popular usage, a type of land may be described as "standing a lot of work." It may repay well the effort put on it or it may not. If it does, it is inherently fertile, but needing much cultivation to release its plant nutrients and keep the weeds down. If not, it may be relatively sterile land and hard to till at the same time.

Machines differ in capacity and efficiency just as land does. A large machine will handle more labor and raw materials than a small one. The dimensions of the cylinder of an engine indicate its capacity for steam or fuel oil, but machines of the same physical dimensions may vary very widely in the amount of other elements which they use to best advantage. Machines may have one set of capacities and efficiencies for labor, another for power, another for the raw materials they handle, and another for management and supervision. Some trucks are efficient in the use of gasoline, others in the use of lubricating oil, others in the use of the energy of the driver or mechanic.

Most noticeable of all are the differences in the efficiency and capacity of human beings. One farm manager may make a large net income by running a large business in a rough-and-ready manner; another, as large an income by running a small business very efficiently. Some men incline toward doing a little work half well; others toward doing a little work very well; and some are able to do a large volume of work very well.

Capacity, it appears from the foregoing, is closely akin to size. The cow with large capacity has a large body and digestive system and a large udder. The large mowing machine is the one with the long sickle bar. The rate at which a machine travels, however, may also determine its capacity, or the speed of revolution of its cylinder. In situations in which a number of units are used in one enterprise — like cows — the size of each unit in itself makes little difference: 15 large Holsteins may consume the same feed and produce the same milk as 22 small Jerseys. Holstein cows have a larger capacity than Jersey cows, for the simple reason that their bodies are larger and they are able to ingest more feed and convert it into more milk. They may not, however, produce more milk per unit of feed than Jerseys. In fact, on the average, the Jersey is likely to prove to be the more efficient user of feed. The type of feed, however, is important. The Holstein may be the more efficient converter of roughage into milk, and the Jersey the more efficient converter of concentrates into milk. The type of product desired must be considered too; is it market milk, or fat for making butter, or solids for making powder, or fat and casein for making cheese? Differences in efficiency are related to physical facts also. Output per unit of power input may be low in a machine because it carries around excess weight, or has a high friction ratio. The high ratio of body weight to udder capacity in a dual-purpose cow makes it relatively inefficient in milk production. A worker may be inefficient because of too much wasted motion or working under unnecessary nervous strain.

Capacities and efficiencies in workers, and especially in managers, must not be considered as fixed and immutable. Especially with younger persons, they can almost always be changed a little, and often doubled, in five or ten years, if efforts to that end are intelligent and well directed. With limited resources with which to work, and lack of capital with which to acquire more, only by increasing their efficiency can many young farm operators accumulate the means wherewith to acquire command of more resources. Other young men inherit farms so large that they never need to operate them efficiently to make a good living from them. This represents a misuse of a nation's resources.

THE COMBINATION OF EFFICIENCIES AND CAPACITIES

THE PROBLEM When a dairy farmer sets forth to buy a cow, he must make a decision, unconsciously perhaps, as to how good a cow he will buy. Even if he wants this cow only for the usual purpose of producing milk and heifer calves, he may pay anywhere from $50 to $300 for it. If he does his buying at an auction, he has the alternatives of perhaps bidding upward from $50 for a poor cow, upward from $125 for a better one, or perhaps upward from $200 for a very good cow. So with all the other bidders at the auction.

This example presents the general problem of the combination of the grades of the factors of production whether it is grades of farmers and of cows, or of farmers and horses, or of farmers and tractors, or of farms and cows, or of farms and tractors, or of farmers and farms. By no means do the grades of the different factors always get combined in an orderly manner. Many individual farmers misjudge their own abilities; and it is extremely easy to misjudge the productivity of a cow; also of a tractor, particularly if it is a used one. The real productivity of many farms is misjudged because they are not now being farmed right. Decisions of this kind affect considerably the earnings of particular farmers and farms.

If individual cows, farms, or machines had productivity ratings, or were put into market grades or classes like wheat and fat livestock, the problem would be easier for the farmer. But even then it would be difficult, for as we have seen, capacities and efficiencies vary separately, and also capacities and efficiencies for different input factors, and the need may be for a particular capacity or efficiency combination. Farm laborers may vary in strength, endurance, industry, intelligence, skill, mechanical aptitude, responsibility, and honesty. A particular job in farming may call especially for one of these attributes, or more likely, for some one combination of them.

THE RULE What rule or principle should a farmer follow in making a choice of a unit of a factor of production? A rule commonly laid down is that no farmer should deliberately choose any but the best — the laborer that will do his particular job best, the land that will give him the largest product for his labor and management, etc. Why should a farmer deliberately choose to buy a poor cow or horse? or for that matter, anything but a very good one?

Unfortunately, however, only a limited number of the good cows are produced. No doubt if all of the recommendations of the geneticists were followed, many more good cows would be born and reared than now, but still there would not be enough to go around. Hence, if the poor farmers buy all the good cows, the good farmers will have to use the poor ones, and surely the total product of agriculture will be less than if the good farmers had the good cows and the poor farmers the poor ones.

But who cares about the total product? someone may ask at this point. What we are concerned with is that the individual farmer do what is best for himself. Prices must be taken into account — the prices of the good cows are much higher than those of the poor ones. We have learned from our analysis of capacities and efficiencies that the good dairymen can make the good cows produce more milk and yield larger net products than can the poor dairymen. The combination of their higher productivities with that of the cows returns larger gross and net products than the combination of the poor dairymen's productivities and those of the good cows. The additional productivities appear to multiply into each other, and not simply add to each other; that is, the results are like 2 *times* 4 equals 8, and not like 2 *plus* 4 equals 6. The good dairymen can therefore afford to bid more for the good cows than the poor dairymen can afford to pay. Thus, economic forces compel a rough distribution of grades of dairymen and cows in such a way that the best of both tend to get together, and the poorer dairymen find themselves with the poorer cows. If the competitive processes worked exactly right, the combinations would be perfectly regular from the lower grades of dairymen and cows all the way to the highest. The mistakes made by farmers in judging their own abilities, and in judging the qualities of the different cows, prevent any such perfect combination.

These mistakes, moreover, have the effect of reducing the spread in prices between the poorest cows and the best, and this may easily give a lower-grade farmer a chance to buy a cow of somewhat better grade than he himself rates at a price that will enable him to make a larger net gain from her than if he bought a poorer cow.

Granted that the foregoing analysis is valid, how can it be applied? How can an operating farmer make use of it in selecting his individual cows and other producing units? At the best, judgment will need to play a large role in such decisions. Good judgment in such matters is one of the attributes of a good farm manager. A clear working understanding of the relationships outlined in the foregoing, however, enables him to analyze more closely and think more precisely.

And such decisions need not be wholly a matter of judgment. If a dairyman has kept records of the cows in his present herd so that he knows the feed and labor inputs of each and also the outputs and sales receipts, he can figure out for each of his cows, from the one that would sell for the least to the one that would sell for the most, his net return after allowing for interest and depreciation. These results will show him at what grade-level of cows he is likely to make his largest return, and guide him in selling his least profitable cows and in buying cattle from other herds.

A similar analysis can be made of the problem of buying a truck or any other item of farm equipment, except that the farmer may have no present experience upon which to judge his inputs and outputs with the different trucks which he might buy. He will have to use instead any data that he can obtain from various sources as to the interest, depreciation, gasoline and oil, and upkeep and servicing costs of the different trucks, and match these against the amount and quality of performance he can expect to obtain from them. The resulting estimates will depend in considerable measure on how much use the farmer is going to make of the truck. If he uses it relatively little, the interest and depreciation overhead on the high-priced truck will be so high that he cannot afford to buy it. The differences would be still larger if the choice lay between buying a used tractor at $500 and a new tractor at $1,800. Several hundreds of thousands of farmers in this country are operating used tractors and trucks who cannot afford to use new ones.

No doubt the foregoing illustrations have carried the implication that only the best farmers can afford to have the best cows, the best machines, the best land, and so forth. The second rule often advanced for combining grades of the factors says exactly this. The full statement of the principle, however, is more selective than this. As we have seen, the productivities of producing units are composites of many things, and frequently a unit that is priced relatively low in the market may have particular properties that fit it best into an otherwise high-grade combination. For example, only a skilled mechanic may be able to use a badly worn tractor at all. A skilled dairyman may sometimes purchase cows that are not doing well because of mistakes in their present handling and secure higher returns from them than if he purchased higher-grade cows at higher prices. A tract of sandy land may have been farmed for many years by a low-grade farmer until it will no longer support him, whereupon a highly capable farmer may purchase a large tract of it at a very low price and make a high return upon it.

What is really involved in these situations is another working out of the principle of comparative advantage. Farmer Anderson, because of his special capacities and efficiencies, can make four tracts of wheatland, M, N, O, and P, return him per acre, above expenses, the amounts in the first line following; and the poorer farmer, Brown, can make these same four tracts net him the amounts in the second line. The third line gives Anderson's ratio of advantage over Brown. Farmer Brown can compete most successfully with Anderson for tracts M and O. If there were no other wheatland available, and no other farmers, Brown would farm these tracts, and Farmer Anderson would be able to bid N and P away from Farmer Brown for just a little more than Brown can make on M and O.

	M	N	O	P
Anderson	$0.80	$1.60	$2.40	$3.00
Brown	0.56	0.96	1.92	1.50
Ratios	10 : 7	10 : 6	10 : 8	10 : 5

No farmer should, therefore, allow himself to be influenced too much by the prices that have come to be established in the market place, or even by the commercially accepted ratings of cows, land, labor, or other factors of production as poor, fair, good, and excellent, or as having low productivity or high productivity. What he needs to know is how they will perform for *him*. In many situations, a unit of a factor of production that is relatively low-priced will yield as large a product when used in combination with him, and the other factors now associated with him, as the higher-priced units. The precise rule for any farmer is to *find the combination of capacities and efficiencies with his own in which his ratio of advantage is greatest.*

Almost needless to state, farm operators do not receive much help in making such choices from the usual data assembled from farm management surveys or experiment station trials. The results are for the most part expressed in terms of averages, or differences between units are presented in terms of broad classes that cover up differences which are highly important in making combinations. The experiment station combinations are nearly all of A-grade factors and A-grade management.

Society as a whole is interested in getting all the units combined in such a way as to obtain the largest total product from them all; the individual, in choosing other units that will give him the largest net product. If competition is full and free, and the different users are fully informed as to the properties of the different units of the other factors, and as to their own capacities and efficiencies, the combinations will be precisely

those which society as a whole needs. As it is, the social product falls considerably short of the optimum, since many factors are not used in combinations in which their ratios of advantage are largest, and in consequence many individuals make abnormal gains and others suffer undue losses.

Since capacities and efficiencies depend upon the grade and type of product, so do the economic combinations of grades of the factors. If the market being supplied pays a premium on quality, the combination of the units of the factors that delivers a high-grade product will have the advantage. If the product is sold field-run, weight of product alone may be the object. Thus, Idaho baking potatoes sell in a market that pays a higher premium than does the market for the ordinary U. S. No. 1 potatoes; and likewise more for "near-by hennery" eggs than for "western eggs." Or the markets served may call for very different types of products, such as light, medium, and heavy hogs, or lard-type and bacon-type hogs; or for short-, medium-, and long-staple cotton. Dairy products provide the outstanding example of this — the market may be for fresh milk, or cream, or butter, or cheese, or evaporated milk, or powdered milk. The Holstein breed may be the more efficient in converting feed into milk measured by the hundredweight for sale as market milk, and the Jersey breed the more efficient in converting feed into butterfat for making butter or cream. Or the answer might be still different if the produce were measured in terms of milk solids to be converted into cheese or into evaporated milk. It is apparent, therefore, that it may not be sufficient merely to talk about the productivity of cows. The market in which the product is sold may be the determining factor. Holstein cows are the more common breed in most northern milk markets because milk testing around 3.6 per cent is the usual minimum requirement, and only a premium market, such as for "Golden Guernsey" milk, warrants producing milk with more butterfat than this.

TYPE SITUATIONS The following more or less typical situations may help us to clarify our thinking further in the problem of combination of capacities and efficiencies. Fuller discussion of the application of the principle just stated is found in the chapters dealing with the management of machinery, labor, and land.

Consider first a familiar situation in the buying of cows. When dairymen dispose of some of their cows, they can be expected to sell those which return the smallest net product. Most cows sold out of herds are either old cows or young ones that have not turned out well. If these

cows are sold because their present owners do not find them profitable, how can others afford to buy them? The answer is that they may have returned some net product to their present owners, but not enough to measure up to their standards. Those who buy them may still make a profit, although not a good one; they may have to be satisfied with this because it is the best they can do if they have to enlarge their herds in a hurry.

Sometimes, also, the buyer is a better dairyman than the seller, and is able to bid high enough for some of the better cows so that the present owner is willing to sell. Such a dairyman may be able to build up a relatively profitable herd by purchasing from other farmers. Ordinarily, such a buyer will have his best luck buying from some of the poorer dairymen who have not fed their cows well enough to discover their worth.

Buyers from city milksheds often come into a neighborhood and pay prices high enough to obtain the better cows. They can do this because market-milk prices are higher than dairymen receive in butter and cheese areas. These higher prices also justify heavier feeding.

A farmer needing to assemble a herd in a few months will ordinarily find his best opportunity at auctions where whole herds are sold. If he is a good dairyman, he will be able to outbid others for the better cows. The senior author once watched a young man, who had served as an apprentice on an excellent dairy farm for several years, assemble a herd at auctions which a year later was the ranking herd in the local cow-testing association. His skillful feeding, of course, also had much to do with the results.

County agents are sometimes assigned the task of helping their farmers buy carlots of cattle in other regions. They may have to make the decision as to the grade of cows to buy and the level of prices to bid. They need always to bear in mind the capacities and efficiencies of the particular set of farmers who are to receive the cows. Buyers of cows for farmers moving onto resettlement projects, or for borrowers under Farm Security Administration loans, have not always used good judgment in this respect — they have at times purchased better cows than the borrowers could pay for until they learned to be better dairymen.

Many of the cows that one will find in the low-income areas of this country seem to be so poor that one wonders whether they should not be culled out at once. The cows frequently look even more "submarginal" than the land. (The term submarginal is used in quotation marks here because this is an incorrect use of the term, as will be explained in Chapter XXVII.) Yet it may very well be that this is the best land that

farmers of their level of capacity and efficiency can bid away from other farmers. The land itself may not be "submarginal" *for them*, and similarly not the cows. Even these cows provide a way of converting the poor forage in the area into human food which otherwise would be lacking.

A parallel problem arises in the *buying of horses and mules*. The argument is not all on the side of the farmers with large powerful well-fed horses. Some farmers cannot afford them any more than they can afford powerful tractors or trucks kept in the best operating condition. Some small farmers may need a team for many two-horse operations on their farms, but do not have enough of such work to keep them well employed. Hence, they may buy inexpensive horses and not keep them in prime condition. Some very small farmers have a very limited use even for one horse. They often equip themselves with an old or infirm animal that still meets their needs after a fashion. Fewer horses are likely to be "submarginal" even than cows.

A parallel situation arises in the hiring of farm labor. The farmer may have a choice between a boy, a youth physically able to do hard work but relatively inexperienced and unskilled, a young man who has acquired his full strength and skill as a farm worker, an older man in the prime of his life who probably would not be a farm hand except for shortcomings of one kind or another (that may not, however, keep him from being a good farm hand) and a still older man who is still a farm hand for similar reasons or may have become one through misfortune. Any one of these has a place in agriculture where he can be useful. But he can easily be a misfit in a particular employment; either because he is too productive a worker for it, or because he does not measure up to its needs.

Finally, as we shall observe in the chapter on the "Size of Farms," many individual farmers and farms get into wrong combinations with each other. Social factors are commonly responsible for this. A young man with good natural ability may find himself inheriting a poor farm or perhaps no land at all, whereas an incompetent son of another farmer may find himself the possessor of a very good farm. The general tendency for good farmers and good land to be found together, and likewise for poor farmers and poor land, seems to be in keeping with the facts in most areas. However, it is only a tendency. The competent young men in the community are generally moving in the direction of better farms or are improving their present farms so as to make them more productive, whereas the less competent young men are moving in the other direction.

WHAT PRODUCTIVE AGENTS TO USE

The third phase of the problem of combining the factors of production mostly has to be discussed in the special chapters in PART FOUR on the management of machinery and equipment, of labor, and of land. Following are examples of management problems coming under this head:

1. Hand versus machine milking.
2. Corn pickers versus hand pickers.
3. Machine versus hand-picking or hand-snapping of cotton.
4. Horsepower versus tractor power.
5. General versus special-purpose tractors.
6. Combines versus binders.
7. Field hay balers versus hay loaders.
8. Field hay balers versus field hay choppers.

Insofar as any new principles are involved in analyzing these problems, they will have to wait until these principles are discussed in chapters immediately to follow. One common method of analyzing these problems is to compare combined costs per acre or per unit of product with the alternative procedures or equipment. The methodology of this is discussed in Chapter XXI. Cost comparisons are commonly not sufficient in themselves. For example, the farmer who buys a milking machine may presently buy more cows and change his whole farm organization. The purchase of a tractor may displace two teams or only one, and also change the cropping system; or it may make the difference between one or two hired men. The yields may be increased by getting the planting and harvesting done in good season, or lowered by wastage. The quality of the product may be affected. Only by comparing receipts and expenditures from the farming systems as wholes with the two types of equipment or staffing of the farm can the full comparison frequently be made.

The most common of all problems of combination raised by such alternatives is that the unit of equipment is too large for the existing scale of farm operations. If it is not possible to make units of some machines — like corn pickers, or cotton pickers — small enough to fit the prevailing farms, this fact may induce some reorganizations of farms or farm practices.

FURTHER READING

John D. Black and Albert G. Black, *Production Organization.* New York, Henry Holt and Company, 1929, Chapter 8.

EXERCISES

1. Construct charts like Chart 61 that will show the differing productivities, capacities, and efficiencies of two clearly differing soil types in your area or states, in the use of fertilizer, labor, or whatever happens to be the most important variable factor.
2. Cite an example from your own community of a capable farmer wisely choosing a lesser-grade factor of production.
3. Make a list of ten farmers whom you know well, and rank them from 1 to 10 for (a) efficiency and (b) capacity as managers for the type of farming followed in your county.
4. If you were going to buy and equip a farm, with a moderate amount of capital, what grade of the various productive factors would you buy? Why? Why do you think these would be best for you? How would you go about trying to obtain the grade of factors that you want? After you had purchased the farm and equipment, how would you go about testing the wisdom of your choice?

CHAPTER XIX

Size of Farms

NO MORE IMPORTANT QUESTION FACES MANY A FARMER THAN HOW big a business he should undertake. Yet when this question was put to a successful farmer recently, his reply was, "I hope you don't waste a lot of pages in your book on questions like that. A farmer should farm all the land he can get hold of. What keeps me and most other real farmers from making as much money as city businessmen, lawyers, and doctors is that we don't have enough capital to get hold of enough land and equipment and cattle."

When the same question was asked a professional writer on farm problems of the "liberal" school, the answer, strangely enough, had much in common with the first: "There is not much use talking about how large a business a farmer should have. Half of them haven't enough land. They are too poor to buy the land they need, or even to buy the equipment and livestock to operate enough rented land. They don't dare buy too much of a farm on credit because owning a farm under heavy mortgage has proved to be very risky business in this country in the last few decades. They don't want to be tenants under the kind of leasing systems we have in this country. They want a farm they can call their own. So they settle down on a small piece of land and don't make enough for a decent living. The real trouble is that the farmers who do have money, and also many city folks with money, are able to buy the land away from the little fellows. So we are having more and more land owned by city folks and in large farms. Three million farmers in this country, as a result, do not have enough land. Many of these we call part-time farmers. They have had to get jobs off their farms in order to make a living for their families. They cannot hold these jobs and really take care of their farms at the same time. So they neglect their farms. The result is that what we call part-time farming in this country is mostly bad farming. During the war we had a big increase in this. Perhaps a half million farm families were working full time in war plants and neglecting their farms most awfully."

Both of these statements imply that the farms of this country are limited in size only because farm families lack the resources with which to buy more land, and that the more land a farmer operates the more income he will have. Neither of these statements is more than a half-truth. Many factors other than these determine the sizes of operating units in agriculture. It is the purpose of this chapter to examine the circumstances that determine farm sizes and see what guidance this can give to a farmer who needs to make a decision on this point. It should be apparent at the outset that the problem of farm size is only a special case of the general problem of combination of the productive agents discussed in the last two chapters. The principles introduced will therefore only be adaptations of ones already presented.

A. *FACTORS DETERMINING PREVAILING SIZES*

The circumstances determining farm sizes had best be considered under two heads: A, factors determining the average or prevailing size of farms in an area, region, or country; and B, factors determining variations in size among individual farmers in an area or region. Many thousands of pages of largely futile controversy have been devoted to the question of "the proper size of farms for a country, region, or area." For the most part, the average size of farms is determined by circumstances that have little relation to any conceptions that economists may have as to what is "proper." The major influences upon size of farms are as follows:

DENSITY OF POPULATION That the most important circumstance determining the prevailing size of farms in a country is the density of its population will be apparent from Table 49, which shows the average size for a selected sample of countries. In spite of much industry, Japan can have only a little land in each farm, unless most of her farm workers are to be hired laborers. As it is, each farm employs 3.8 workers. Switzerland has comparatively little arable land relative to her population. France and Denmark are still conspicuously agricultural. Only 7 per cent of the dense population of England is engaged in farming, and an average of 6 hired laborers per full-sized farm. Canada, Argentina, and Australia are still newer countries than the United States, with still larger proportions of low-output acres. Canada has been expanding westward in the last three decades more rapidly than the United States. If the United States or any of these countries is to have larger farms than now, it will need to (1) *reduce its population;* or (2) *shift more of its people to city employment;* or (3) *have more hired laborers per farm;* or (4) *achieve*

some combination of these. If Sunflower County in the rich Delta lands of Mississippi is to raise its average of 34 acres per farm in 1940 to the average of 184 acres in Douglas County in the rich Corn Belt lands of Illinois, it too must do one or more of these same things.

TABLE 49. AVERAGE ACRES PER FARM IN SELECTED COUNTRIES AT MOST RECENT CENSUS (1929–1937) AND AN EARLIER CENSUS

Country	*Most recent census*		*Earlier census*		
Japan	2.7		2.5		(1903)
Greece	9				
Switzerland	15				
France	29		27		(1911)
Denmark	39		40		(1919)
England	82		66		(1907)
United States	158		146		(1899)
Canada	234		124		(1901)
Ontario		119		105	
Saskatchewan		408		285	
Argentina	266				
Australia	665				

Source: J. D. Black, R. H. Allen, O. A. Negaard, "The Scale of Agricultural Production in the United States," *Quarterly Journal of Economics*, May, 1939.

The distribution of farms by size-groups in these countries is also worth observing in Table 50. The size-group "under 2.5" in France included 26 per cent of the farms compared with 21 per cent for "under 50" in Australia. The densely populated countries have a heavy concentration of farms in the lower size-groups, like our own South.

OPPORTUNITIES FOR OTHER EMPLOYMENT If other employments, by offering higher wages or better working conditions, draw part of the working force away from the agriculture of a region, the farms will increase in size. On few occasions in modern history have farm and urban earnings and living conditions been equalized in any country. This is because birth rates are higher on farms than in cities, and because a declining fraction of the rising incomes of people is spent for food and fibers. Increasing use of labor-saving machines has been an added factor in recent decades. Seldom has migration been fast enough to offset these influences.

TABLE 50. PERCENTAGE DISTRIBUTION OF TOTAL NUMBER OF FARMS AMONG ACRE SIZE-GROUPS, SIX COUNTRIES

Japan 1935 Size-group (acres)	Percentage of farms	*France 1929* Size-group (acres)	Percentage of farms	*Denmark 1936* Size-group (acres)	Percentage of farms
Under 1.25	34.8	Under 2.5	26	1.38–7.5	14
1.25–2.50	34.1	2.5–12.5	29	7.5–25	38
2.50–5.00	21.9	12.5–25	18	25–75	32
5.00– 7.50	5.7	25– 50	15	75–150	11
7.50–12.50	2.3	50–125	9	150–300	3
12.50 and over	1.4	125–250	2	300–600	2
		250 and over	1	600 and over	0

England 1936 Size-group (acres)	Percentage of farms	*Argentina 1935* Size-group (acres)	Percentage of farms	*Australia 1933–1934* Size-group (acres)	Percentage of farms
1– 5	18.1	Below 25	6.7	1– 50	21
5– 20	24.3	25– 62	19.6	50– 100	11
20– 50	19.0	63– 125	17.6	100– 500	37
50–100	16.1	126– 250	20.3	500– 1,000	15
100–150	8.7	251– 500	23.9	1,000– 5,000	15
150–300	10.0	501– 750	7.7	5,000–10,000	1
300–500	2.8	751–1,625	3.6	10,000 and over	0.1
500–700	.6	1,626–2,500	.4		
700 and over	.4	Above 2,500	.2		

Source: *Ibid.*, pp. 356*f.*

The process by which labor leaves the farms under these conditions takes two forms, to which the simple words *pull* and *push* can be applied. In normal years, a considerable fraction of the young people on the farms are each year *pulled* to the cities by the prospects of higher earnings and/or better living. More are pulled to the city in good times than in bad. Estimates have been made that five millions moved from farms to cities in the United States between 1920 and 1930. But part of these went back to the farms in 1931–1933. Perhaps four millions were dammed up back on the farms in 1939 because of continuing unemployment in cities. They were mostly not unemployed on the farms; they were

under-employed. Usually many more have gone to the cities seeking jobs than have been able to find them. There is a constant large flow in both directions, part of it seasonal and part of it not. Those farm workers who have gone to the cities for winter work have usually returned to the farms only because they have not found summer jobs.

When the *push* operates, people leave the farms because they cannot make a living there any more. This happens when a machine comes in that is so much more efficient than hand labor that it takes away the workers' jobs. It does this in part by making the price of the product so low that farm families cannot make ends meet any more unless they use the machine. Thus the making of cotton cloth in factories in India starved out the families that had spun and woven by hand in their homes. Gandhi, it will be remembered, asked for a return to the spinning wheel. The Russians did not make this mistake; nor the Japanese. A disaster, like the boll weevil, or the Dust Bowl drouth, may also force farm families out.

The push process is revolutionary, and hence painful. But its total effect is usually beneficial. One generation suffers, but those following are much the better for it. Without such revolution, it is doubtful if the problems of India or China will be solved and probably not those of our own South. The mechanical cotton picker, to be discussed later, is likely to operate on the push principle. The new developments in sugar-beet growing, *i.e.*, seed treatment to save thinning, and mechanical harvesting, will reduce greatly the use of migrant gang labor. As will be indicated later, the push principle may soon begin to operate somewhat in some dairy-farming regions.

LAND TENURE The term *tenure* is used in this book to include all the varying relationships of people to the land out of which they get a living. Tenure means, in strict parlance, *rights to the use of land.* This means that farm laborers, croppers, tenants, and owners all have land-tenure rights of one sort or another.

As already indicated, the size of farms can be increased if more of the present owners become hired laborers. If no other change occurred than this and all men now operating the small and poor farms in the country were to become hired hands for the more successful farmers on the better farms, and their land was absorbed by adjacent farms, the number of farms would be reduced greatly. Agricultural output and probably national income would be increased at the same time. If the enlargement of the farms made it possible to use more power and machinery, the land could be cultivated more intensively and more live-

stock could be kept. But at the best, some of the families would need to migrate to other areas or to the cities.

In general, rented farms are larger than owned farms, and share-rented farms are larger than cash-rented farms. Young men climbing the agricultural ladder have a choice of becoming tenants on larger farms or using their limited resources to purchase small farms. They climb faster usually by becoming tenants first, and staying so for five to ten years or more. Differences in practice in this matter appear within the United States. For example, in Wisconsin, the average size of the farms in Kewaunee County is 104 acres and 7 per cent of the farms are rented, whereas in Grant County the average size is 170 acres and 40 per cent of the farms are rented. Kewaunee County is on the eastern side, and Grant in the southwestern corner. For the state of Wisconsin as a whole, the average size in 1940 was 122 acres and 16 per cent of the farms were rented. The average size in Iowa was 160 acres and 48 per cent of the farms were rented. Many of the farmers in eastern Wisconsin are of recent European origin, and they brought over with them from Europe the tradition of ownership of smallholdings. Many millions of larger farms in Europe were carved up in the last century to make smallholdings for farm laborers. The Iowa farms have adhered closely to the homestead of 160 acres.

THE FAMILY AS AN OPERATING UNIT Differences among families in size influence greatly the sizes of particular farms, but the family as the usual farm operating unit strongly determines the prevailing size of farms. In all countries there appear to be factors that keep farms from expanding in size beyond a certain middle range. Institutional arrangements no doubt account for this in part. Many nations have passed laws to prevent the concentration of agricultural wealth in a few hands. The breaking up of farms through inheritance wherever primogeniture has been abolished is another factor. But some of the limiting factors operate within any one generation. The more important of these have to do with the economy of the middle-size or family farm as an economic unit. Hired labor is clearly more costly than the family labor of those members of the family who stay at home and who must be fed and clothed whether they work or not. To be sure, it would be better if the boys and girls could find better-paying jobs in the neighborhood. Frequently some jobs are available on larger farms near-by, and if more farms were large, there would be more of such work. But except in certain types of farming, this combination has thus far not proved as effective as having the young people work at home. Hence, once the

point is reached where a farm must call in regular hired farm hands to keep the work going, the whole economy of the enterprise is changed and the out-of-pocket expenses of the farm rise abruptly.

Farms depending on family labor only are also more adaptable to changing price levels. The wages of hired laborers do not change promptly with prices, whereas family laborers receive as their remuneration whatever is left after the fixed expenses of the farm have been met. Family farms are thus able to survive periods of unfavorable price relationships which may undo farmers depending upon hired labor. Usually when farm prices are low, other prices are also, and opportunities to shift to nonfarm employment are scarce.

It must also be remembered that the living obtained from the farm tends to be a constant with increasing size, and hence a larger fraction of the income of smaller farms. This part of the farm economy is not subject to the effects of adverse price relationships. We have already noted that the living from the farm is a sizable item if use of the dwelling is included and food and fuel are valued at their real economic importance to the family.

Important also are the savings possible on middle-size farms from diversification and taking fuller advantage of supplementary and complementary relationship between enterprises. These alone seem almost sufficient to check expansion in farm size in regions like our Northeast and the North Central states where climate and topography induce a combination of feed and forage crops with livestock farming. Finally, in spite of the increasing use of fast-moving farm trucks and tractors, mere distance from the farmstead is still influencing size downward.

None of these factors, however, prevents growth in size of the middle-group farms. In many sections of the United States, an average-size farm family can handle, with modern power equipment, fully twice as many crop acres as in 1910, and do it with more ease. The Midwest and the Great Plains have responded most to these influences thus far, but other regions are about to join the procession. Densities of rural population will, however, be a retarding influence in many areas. If many middle-size farms double in acreage, there will be fewer of them. Though they may employ a little more labor because of shifting more into livestock production, the increase in workers per farm will be small. The expansion of city employments must absorb the labor released or the movement will be retarded. Public policy in the United States at present is to establish farms around the minimum, and especially not below it, for an average family. The Bankhead-Jones Act explicitly defines such a minimum. The amount of land meeting such a minimum

has been carefully determined for an area in central South Dakota practicing grain-livestock farming as 480 acres.[1] McNall and Hall conclude that 60 to 80 acres can be enough if intensive dairy farming is practiced in Wisconsin.[2]

WEALTH We are now in a position to consider the contention made in the opening paragraphs of this chapter, namely, that the lack of capital is the principal factor determining the size of farm businesses. No doubt a large fraction of the present farmers of the United States, perhaps as many as a third, would operate larger businesses if they had the capital or the credit wherewith to buy more land, livestock, and equipment. The Texas Agricultural Experiment Station has estimated that 268,000 farms could produce more than the 417,000 farms in that state were producing before the war if the small farms were to enlarge to full family-size farms; and these estimates do not include the part-time farms.[3] The smaller farmers, however, would need the capacity and efficiency to use the larger acreage. If they lacked this, they would reduce their net incomes by enlarging their businesses. The reason that many families do not have the resources with which to buy more land and livestock is, of course, that they have not been using efficiently what they have.

Equally important, if a large number of these farmers were to start out to expand their opportunities all at once, they would increase the demand for land and its price would rise prohibitively. The simple facts of the matter are that thus far in this country the need of the smaller farmers for their present land has been so great that they have been able in the main to hang on to what they have against the competition of those who would like to have more land. Forty acres of land upon which a farm family can make some kind of a living means much more to this family than it does to the owner of a 160-acre farm in the same neighborhood who would like to buy it — at least until such time as the family on the 40-acre farm can find some more remunerative employment elsewhere. The farmers with the larger capacities cannot ordinarily bid high enough for land to take it away from at least the more efficient of the smaller farmers. Earnings from other employments may enable city people to take title to such land when those obtained from agriculture cannot. But they usually become landlords rather than owner-operators.

[1] J. L. Paschal, A. G. Nelson, and O. Rogeness, *Planning Minimum-Sized Farms for the Beadle County Area in Central South Dakota*, South Dakota Bull. 341, 1940.

[2] P. E. McNall and I. F. Hall, *Managing the Farm for Better Income*, Wisconsin Bull. 429, 1934.

[3] U.S.D.A., Bureau of Agricultural Economics and Texas Agricultural Experiment Station, *Agricultural Production Texas 1950*, 1945.

Actual possession of the wealth needed to enlarge a farm business is of course not necessary — credit can take the place of such possession. But our present agricultural credit system does not make credit available to those who really need it most. The ones who really need it are those who already have mortgages on small farms and are having difficulty carrying even the mortgage which they have because their farms yield such small returns; or they are not mortgaged but their earning power is so low on their present farms that lending agencies do not consider them safe risks. Farmers in either of these situations are in a vicious circle. They are not able to borrow because they have so little resources; and only with great difficulty can they increase their resources without borrowing in order to secure command of more resources. This subject will be discussed further in the chapter on "Financing the Farm Business."

Credit can also be an important factor in reducing the prevailing size of farms. The extensive use of public credit to break up estates into smallholdings in Europe is an excellent example of this. In some sections of this country the farmers of European origin still tend to buy small farms under large mortgages instead of renting. The Bankhead-Jones Farm-Ownership program, if rapidly expanded, would surely reduce the prevailing size of farms — not below family-size, however.

DELEGATION OF MANAGEMENT A factor restricting the expansion of farms above middle-size is the difficulty of delegating management in agriculture. Most types of farming do not lend themselves easily to being run by foremen or hired managers. As has been made abundantly clear by now, diversified farms are highly complex organizations. If the farm business is large enough to have an assistant manager in charge of each of its departments, there is still a major task of integrating the work of the departments. A smaller business with one foreman or assistant manager must rely on him for the same acuteness of interest in the results and the same grasp of the farm business as a whole as an owner-operator gives to his enterprise. Hired managers with these qualifications are scarce, and get very well paid in other lines of endeavor.

TEAMS, WORK CREWS, ETC. A major controlling influence in many situations today is the capacity of the prevailing power and other machine units. The size of a farm that one man can handle with one tractor, and tillage and other equipment to go with it, is bound to influence much the type of farm that prospers in an area. The recent development of smaller types of equipment may make feasible the continuation of many smaller farm units. But these smaller farm units will

not provide as efficient use of labor as the larger ones. In addition, the economies of using very large units in some situations — for example, Diesel-powered tractors in wheat farming — may cause farms generally to increase in size in some areas. Farms may be too small to use one type of tractor effectively, and too large to use smaller-sized outfits. Renting additional land is often the best way of solving this problem, or doing custom work for the neighbors, or hiring custom work.

Where tractors are not used, the capacity of a team of horses or mules may influence prevailing sizes specifically. Farms tend more or less to be large enough to use one team efficiently, or two teams, or three, and not some size in between. In the South, the division may be between one- and two-mule farms.

Closely related to the foregoing is the capacity of a work crew. On many farm operations, a crew of two men, or three, or more, is needed to use labor and equipment efficiently. An extra helper or two can be hired if this operation comes only a few times a year and if the labor is available, or exchanging work with neighbors may be the solution. But if such operations come frequently during the year, the farms tend to be large enough to keep a full crew regularly employed most of the time.

The tractor units now used in the Corn Belt and in an increasing number of other sections of the country require a two-man crew to utilize them effectively. As a result, a strong movement is under way toward two-man farms in these sections. The family may supply the labor force for such a crew, in the crop season at least, or one man may be hired for the year or season. If smaller farms are going to compete successfully with these two-man-crew farms, equipment and methods must be developed that one man can use.

ONE-MAN, TWO-MAN FARMS, ETC. The discussion under the last head leads up to the related tendency for farms everywhere to be about large enough for one man, usually with some help from his family, to handle comfortably; or large enough for two men to handle with such assistance. Beyond two, more flexibility is possible. If the land on a farm is too much for one man or for two men to cultivate with the prevailing intensity in the area, more than the usual amount of it will be in hay or other extensive crops; and contrariwise. In this book, sizes of farms are therefore more often given in terms of number of men than in any other way.

ECONOMIES OF SCALE IN PRODUCTION There still remain certain economies in production from mere increase in size. A larger farm, up to a

certain point, can have lower building costs per unit of livestock housed, or of feed stored. Its larger fields can be fenced at lower costs per acre. Perhaps to a limited extent, the tractor costs are less per acre with larger than with smaller tractors. They surely are if the larger units are Diesel-powered. Most of the real economies of scale arise merely from the easier fitting together of the capacities of men and machines and acres on larger farms. These same fits can also be obtained, however, on smaller farms.

More important by far than these economies are the gains from more specialization in the working force, and in management, and from the better access to markets, to credit, and to improved methods of production, that the larger farmers are likely to have.

It must also be pointed out that although small farms, like the 60- to 80-acre Wisconsin dairy farms mentioned above, can be well managed, a majority of them are not. They tend to be operated by families who are satisfied with a low level of income, and who have poorer cows and lower yields than the larger farms. They are commonly operated by farmers with low capacity and efficiency. The really successful small farms are operated by farmers with high efficiency and either low capacity or a personal preference for intensive methods or types of farming. Nothing more than an inability to handle hired labor may be the limiting factor on capacity.

TYPE OF FARMING Obviously, type of farming affects size of farms greatly. Those products which lend themselves to standardized methods or to the use of large-scale equipment tend to be produced on larger farms than those produced on the diversified systems of farming. Measured in acres of land, the range in average sizes in 1930 was from 60 acres for truck farms and 72 for cotton farms, to 352 for cash-grain farms and 2,910 for stock-ranches. The parallel figures for values of products were $2,880, $1,030, $2,940, and $7,170. The part-time farmers averaged 47 acres and $370 of products; the self-sufficing, 70 acres and $420.

HISTORICAL FACTORS The sizes of farms in many areas are not well adjusted to the current situation mainly because they still conform to conditions that prevailed in the past. The simplest example of this is the way in which size is still determined in the Midwest and West by the rectangular survey and the 160-acre homestead. In Chapters XLIV and XLV on "Cattle Ranching" and "Sheep Ranching," we shall see how the homesteads were seldom large enough for livestock farmers and how the ownerships that were set up by the program have

interfered with the creation of economic ranching units. In order to have economic units anywhere west of Minnesota and Iowa, a large amount of renting from absentee owners is necessary. In the Corn Belt to the east, the prevailing size pattern that seems to have fitted conditions two decades ago persists to the extent that in 1936 it was forcing one out of every four farmers in Deer Creek Township, selected as typical of north central Indiana, to make up his farm out of two to four separately located tracts of land, some as far as seven miles from the home farm. The additional land was both owned and rented, but more often rented.[4] Chart 63 shows a similar situation in an area in Darke County in western Ohio. The need for such combination is greater in the formerly timbered sections than in prairie sections because the difficulty of clearing land caused many of the first and second generation of farmers to sell part of their original tracts, or to buy smaller tracts in the first place.

MEASURES OF SIZE

Before proceeding to discuss factors determining differences in size among farms in one area, we need to define our measures of size. The most commonly used measure is land area — acres, hectares, etc. This is the only measure consistently used by the United States census and also by the censuses of other countries. Obviously, 640 acres of ranch land, of dry-farming land, of Corn Belt land, and of Delta cotton land, do not make farming enterprises of equal size. Neither do 80 acres of dairy-farming land and 80 acres of orchard land. One acre in greenhouses, or 5 acres in a poultry farm, may turn out a larger product than a 160-acre dairy farm. In recent enumerations, the census has also used gross value of product as a measure of size. It has the advantage of including the productivity of the buildings as well as of the land, and also that of labor, livestock, and equipment used on the farm, and of the purchased feed and supplies. It can be used to compare sizes of such diverse types of farms as ranches, corn-and-hog farms in the Corn Belt, dairy farms, poultry farms, and greenhouses. Its major disadvantage is that it makes those farms appear unduly large which, like factories, have a high turnover of feed and labor and other variable inputs. It thus makes the dairy and poultry farms of the Northeast, which purchase much of their feed, appear relatively larger than the Midwest dairy farms which produce their own feed.

[4] J. R. Hays, *Relation of Character of Farming Units to Land Management in Two Townships in Indiana*, Indiana Bull. 450, 1940.

We learned in the preceding chapter that the true equivalent of size is *capacity*, and that capacity is measured in *inputs* and not *outputs*. What is therefore needed is an over-all measure of the *factors of production that enter into output*, and not output itself. Output reflects efficiency as well as capacity. Single input factors are now frequently used as measures of size. The number of cows furnishes a pretty fair basis for compar-

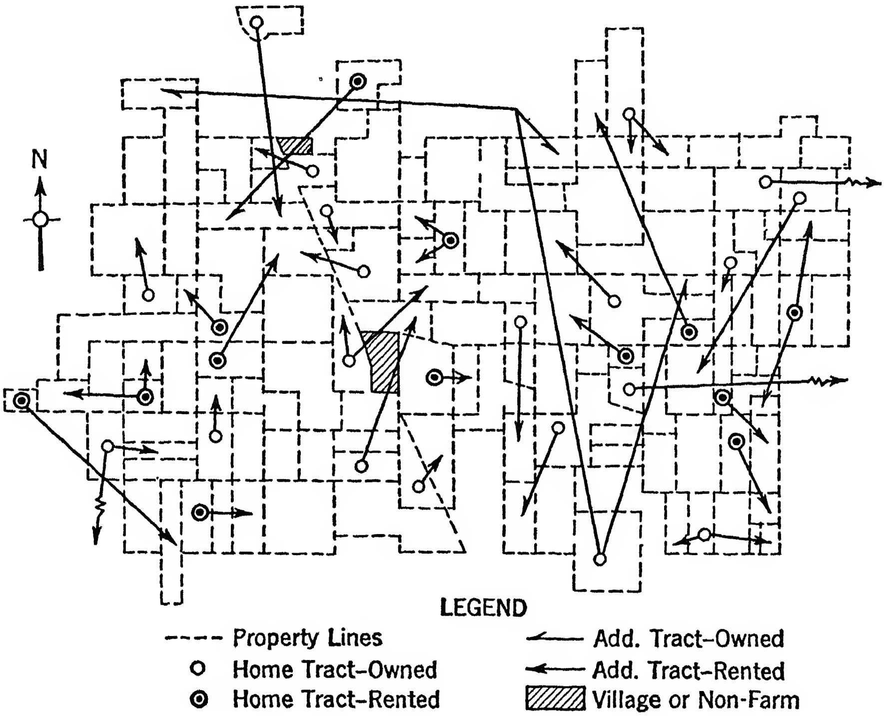

CHART 63. Combination of separate tracts into operating units in Darke County, Ohio, 1940. (Reproduced by permission of the Ohio Agricultural Experiment Station from Bull. 637, R. C. Headington and J. I. Falconer, *Size of Farm Units as Affected by the Farming of Additional Land*, 1942.)

ison of sizes of dairy farms provided all of the farms buy an equal proportion of their feed and the cows are all of similar breed. The number of cattle on ranches will serve equally well provided the same marketing practices are followed. Similarly, poultry farms may be measured in terms of the number of layers. The different classes of livestock can be combined into one measure, *productive animal units*. The weightings now used by the United States Department of Agriculture in computing animal units are as follows: milk cows, 1.00; beef cows, 0.75; cattle on feed, 0.74;

other dairy cattle, 0.44; other beef cattle, 0.34; hogs on farms, 0.27; all sheep and lambs, 0.15; hens, 1.38 per 100; broilers, 0.26 per 100. Iowa farms in 1940 averaged 38 such units; Wisconsin farms, 20; Kansas farms, 17; and Wyoming farms, 69.

The input of man labor is also often used separately as a measure of size, either in the simple form of number of workers per farm, or of *productive man-work units.* These latter are computed by multiplying the acres of each crop grown by the average amount of labor commonly applied to it in the area, often referred to as the *labor requirement,* and similarly for each kind of livestock and for the general chore and upkeep work on the farm. A certain number of hours of labor thus computed, commonly ten hours, is called a man-work unit. In 1940, the average farm in New Jersey employed 2.4 workers; in Alabama, 1.9; in Kansas, 1.4; in Iowa, 1.8. The Iowa farm had a value of product ten times that of the Alabama farm.

Another input measure often used is the *total investment, or farm capital,* that is, the sum of the values of land, buildings, livestock, machines, equipment, and feed and supply inventories. This is a better measure than gross value of product because it is less affected by crop failures.

A true over-all measure of size calls *for using all the inputs* and *reducing them to an annual-cost basis.* Land is included either on the basis of interest plus depreciation and upkeep, or an annual cash rental; farm machinery on the basis of interest and depreciation plus upkeep; likewise, the investment in horses, cattle, and other livestock; feed on the basis of the average feed inventory during the year both purchased and home-produced; likewise, other supplies. The annual labor input needs to include an estimate of the value of the labor of the members of the family as well as that of hired labor; and take account of the period that elapses between the doing of the work and getting back the product from it; that is, it must be converted to an inventory basis like feed and other supplies. Table 51 following compares in terms of these various measures of size a group of farms for which operating statements have been presented in earlier chapters. The Los Angeles dairy farm is only three fifths the size of the Indiana feed-livestock farm on this basis, although it has twice the sales. It is only twice as large as the Wisconsin dairy farm, although having nine times the sales. The Indiana farm gets a relatively quick turnover in its feeder cattle and hence sells five times as much product as the Wisconsin farm. But in terms of annual inputs it is only three times larger. The Oregon wheat farm is the largest because of the large investment in land. The measure which correlates most closely with annual inputs is total investment or working capital,

and it is much easier to calculate; hence, probably best for practical working purposes.

Even annual inputs do not allow for one important element in the problem — the amount of management required by the different input factors. The Los Angeles dairy farm may have more capacity for management than its annual inputs indicate.

TABLE 51. SIZE OF NINE FARMS ANALYZED IN EARLIER CHAPTERS

	Years	*Acres*	*Crop acres*	*Gross value of product*	*Productive animal units*	*Number of workers*	*Total investment*	*Annual inputs*
Two-man Aroostook potato [a]	1939	170	118	$9,040	3.9	3.5	$21,200	$4,200
Indiana feed-livestock [b]	1943	220	157	14,100	50.0	2.2	37,000	5,000
North Carolina tobacco [c]	1939	85	32	1,030	3.2	2.0	3,760	600
Texas Black Prairie cotton [d]	1941	60	41	880	4.0	2.0	4,230	700
Oregon wheat [e]	1935–39	2,200	750	9,980	30.0	2.2	53,500	6,000
Georgia mixed [f]	1942	157	107	3,170	4.8	2.8	7,150	1,300
North Dakota mixed [g]	1939	320	200	3,050	28.0	2.1	15,500	2,400
Wisconsin dairy [h]	1943	115	59	3,140	23.4	2.0	10,500	1,600
Los Angeles dairy [i]	1941	10	1	30,790	92.0	3.5	24,800	3,000

[a] See p. 139. [b] See Ch. XII. [c] See p. 162. [d] See p. 173. [e] See p. 181. [f] See Ch. X [g] See Ch. XIV. [h] See Ch. XII. [i] See p. 191.

It is obvious that measures with values in them can be used only for making comparisons among farms at the same price levels. If an historical trend is to be measured, a rough correction for changing price levels can be introduced by dividing the gross values of product or other value measures by index numbers of wholesale prices of farm products in the different years, as is done in the following for the United States. According to this measure, farms have really been increasing markedly in size in the last twenty years.

YEAR	GROSS VALUE OF FARM PRODUCT PER FARM	INDEX NUMBERS OF WHOLESALE PRICES OF FARM PRODUCTS (1935–1939 = 100)	GROSS VALUE OF PRODUCT IN 1935–1939 DOLLARS
1919	$2,740	207	$1,320
1929	2,200	138	1,590
1939	1,570	86	1,830

B. *FACTORS DETERMINING DIFFERENCES IN SIZE AMONG FARMERS*

That a number of the factors that influence the average size of farms in an area or region also produce differences among farmers, scarcely needs comment. These include especially tenure, the size and composition of the particular farm family, the resources of the family and its access to credit, and the equipment of the farm in workstock and machines. In addition to all these are the differences in the capacity and efficiency of the individual farm operators. If a farmer undertakes to manage a farm enterprise which is beyond his capacity, he does not get full use out of his labor and other factors of production and his unit costs rise. Some operators obtain their highest net outputs by handling a small farm with great care as to details and others from handling larger farm businesses and watching the main chances. The wide differences that one finds in the capacity and efficiency of farm operators may result from differences in natural abilities or from training and experience. How willing an operator is to put forth effort and to exercise close supervision over details, and how much value he places upon the returns which he receives for his efforts, are as important as natural ability.

Management is such an intangible thing that some economists say that it is useless to discuss the question of ratios of management to the other elements. It is indeed difficult to measure management with any degree of statistical exactitude. It is also an exceedingly variable quantity so far as any one manager is concerned. Yet management does get weighed out and proportioned to the other factors in the various economic processes, and the proportioning is done with sufficient regularity and certainty so that definite tendencies are everywhere manifest. Management, for example, varies with volume of business with some degree of regularity. As businesses increase in volume, the management presently finds itself overtaxed and begins to neglect important details. If it is a manufacturing plant, perhaps presently the manager finds sales falling off in a certain territory because of a lack of supervision of details in that area; or complaints begin to come in because some of the materials used in manufacturing were not selected carefully enough.

Agriculture by nature calls for much attention to details. No two operations are exactly the same. Very little of the work repeats itself exactly from day to day. The nearest exceptions to this are such operations as milking and cleaning the barns. Each worker, and each individual cow, horse, or machine, needs to be separately supervised in

many cases. When the grain binder and the threshing machine came into agriculture, they brought with them the need to keep them in good working condition if valuable hours were not to be lost at critical periods.

In the last analysis, it is mostly labor that is supervised; but not altogether. The more equipment each worker uses, the more supervision required per man; also the more land over which each worker spreads his activities. Consequently, it is proper to say that all the factors or agents of production are consumers of management. Each of them consumes management at its own rate. The proportion of the different factors will therefore affect the rate at which management is consumed. Perhaps it is simpler to say that each productive agent has its own "complement" of management. The complement of management required by an agent, or in other words, the capacity of any agent for management, determines how many units of the agent will be associated with an operator and, hence, becomes a factor in determining the size of the business.

One reason will now be apparent for the prevailingly small size of farm and store and hand-trade enterprises. In all of these, labor is employed under conditions that give it a large capacity for management. Even the materials worked with are of such nature that labor employed upon them requires close supervision.

It follows from the foregoing that the best setup in many cases consists of a farmer as manager supervising his own work as a farm laborer and very little more. Many farmers never succeed in encompassing successfully the second step, that of supervising the work of another man or two working along with them side-by-side. Between this step and the next one, that of directing the labor of several farm hands without working side-by-side with them, is a still wider gap. The failure of a great majority of our present farm operators to bridge the gap to the first and to the second of these steps goes a long ways toward keeping farm sizes within their present limits.

In consequence, if a cross section is taken of all the farmers in an area at a particular time, many misfits will be discovered. This is apparent in Chart 64 in which each of 118 Wisconsin dairy farms operating in 1937–1941 is represented by a dot. The average net farm incomes are measured on the vertical axis, and sizes of farm business measured in terms of total value of investment, on the horizontal axis.[5] If the

[5] Number of cows is not a good measure of size of these farms because of differences in amount of purchased feed, in number of heifers raised, in number of hogs sold, in other supplementary enterprises, and in breed of cattle.

farmers in this state ranked the same in efficiency as in capacity, and if each was exactly fitted to the farm on which he was located, all of the dots in this diagram would lie along the line MN; that is, the larger farmers would be on the larger farms, and contrariwise. The farmers in Group A on this diagram are obviously not handling their enterprises in such a way as to obtain the expected return from them. They are inefficient farmers. The farmers in Group B, in contrast, have farms

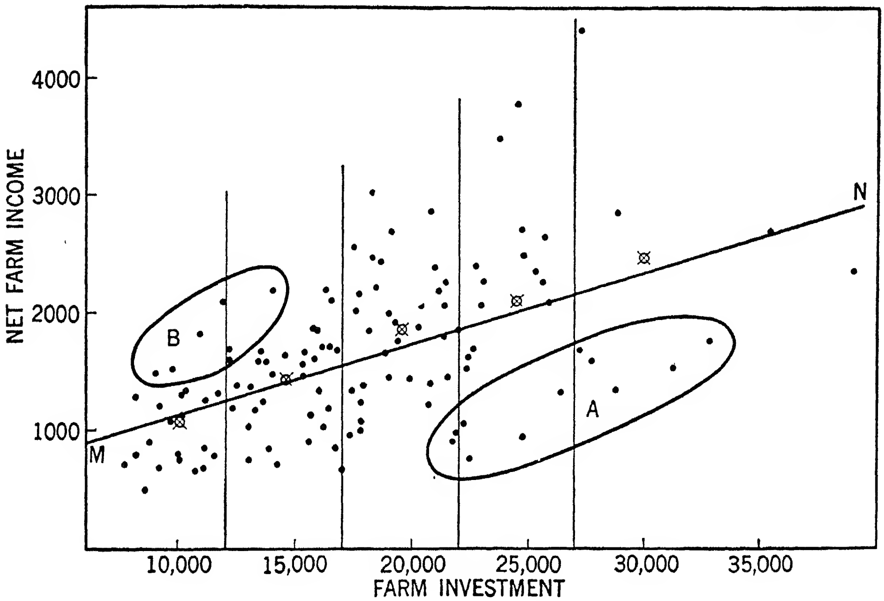

CHART 64. How net incomes and sizes of farms measured in farm investment were related on dairy farms in Wisconsin in 1937–1941. (These are five-year averages of farms which kept accounts in Wisconsin for all these five years. The data were supplied by the farm accounting service of the University of Wisconsin College of Agriculture.)

probably too small for them and are making up for this as best they can by farming what land they have with a high degree of intensity and probably with high efficiency. The farmers located close to the line apparently have average efficiency and capacity and have managed to get themselves established on farms of average efficiency and capacity. The wide distribution of dots in the diagram indicates both misfits in capacity and differences in efficiency. Until some method is found of measuring efficiency of farmers, it is not possible to say what misfits are due to each.

When the farm sizes and net incomes of these 118 farms are put into size-groups and averaged in the conventional manner as in Table 52, the wide variations appearing in the chart are largely covered up. The stars on the chart are the averages for all the farms in each of the five size-groups. It may appear from the table that all any farmer needs to do to increase his income is to enlarge his farm business. This certainly cannot be concluded from the chart.

TABLE 52. NET FARM INCOMES OF THE 118 WISCONSIN DAIRY FARMS SHOWN IN CHART 64 AVERAGED ACCORDING TO SIZE-GROUPS, 1937–1941

Farm investment	*Number of farms*	*Net farm incomes*
Under $12,000	23	$1,190
$12,000–$17,000	35	$1,420
$17,000–$22,000	33	$1,850
$22,000–$27,000	18	$2,090
$27,000 and over	9	$2,460

OBTAINING THE BEST SIZE OF FARM

No one can tell any farmer, it should now be apparent, how large a farm he should attempt to operate. In considerable part, the answer depends upon his personal resources and desires as well as upon his capital resources and credit. No optimum size of farm fits all the farmers in an area, nor even a majority of the farmers in an area. But some of the factors that influence any sound decision as to size of business can be analyzed. These have been carefully stated in the preceding pages. It remains for each farmer to weigh these factors in the particular situation that confronts him.

The decision which he makes will depend much on the method which he follows for changing the size of his farm. As a last resort, he may sell his present farm and choose another nearer to his capacity. Buying additional land, or selling excess land, is often a better method if the present farm is otherwise satisfactory. The buildings in the present farm, however, may not fit the new enterprise. Renting additional land is suitable only as a temporary arrangement or if the right kind of leasing terms can be arranged. Most additional-rented land is abused. The safest method of all, in some situations, if only a moderate increase

in volume is wanted, is to intensify the production on the present acreage. This can be done by such means as the following:

1. Improving some of the land now in the farm by drainage, clearing, terracing, pasture improvement, woodland improvement. Nothing more than fertilizing the corn crop liberally will go far in some Southern states.
2. Growing more alfalfa or kudzu.
3. Feeding more of the grain to livestock and selling less for cash.
4. Building another silo and feeding more steers or keeping more milk cows.
5. Buying more feed and keeping more cows.
6. Enlarging the poultry or some other supplementary enterprise.

In large sections of the United States, however, the farming is more intensive now than was warranted by prewar demands for the particular farm products being produced. Any intensification of production in such areas therefore needs to be pointed toward other lines of production.

The method of analysis for any individual farmer to follow in determining whether to enlarge his operations, and by what means, is relatively simple when farms are enlarged by all but the first of the methods described. On the basis of his records of past operations, he can set up alternative budgets in which he pre-estimates the effect on his net income of farming additional acres of land, bought or rented, that are within reach in his neighborhood. He can do the same with several promising alternatives as to additional feed crops, cows, or hens, and more purchased feed on his present farm. If his budget pre-estimates are too optimistic and fail to take account of his capacity to handle additional land or livestock efficiently, and to look after additional details of management, the result of his actual operations will reveal this in a year or two, and he will be checked in expanding his business any more. Or he may find that the burden of managing the larger enterprises is more than he wishes to carry. Mistakes in pre-estimates are easier to correct if the additional land is only rented, or if only more livestock has been bought.

The methods of analysis to pursue in exchanging a smaller farm for a larger one are outlined in more detail in Chapter XXXIV on "Buying or Renting a Farm." It can be pointed out here, however, that in general they consist of estimating, on the basis of the best available data, the probable receipts and expenses of the farm which is being considered for purchase, and matching these against the receipts and expenses on the present farm. The only basis upon which the farmer can judge

how effectively he will be able to manage the larger farm is his experience on the present one. Therefore, he should first test himself out as much as possible on his present farm by expanding operations on it according to the methods just outlined.

LARGE-SCALE FARMS

The factors determining the size of what may be designated as large-scale farms are enough different from those for middle-size and smaller farms so that they require brief attention. Such farms, it is now apparent, are in the main merely farms on which some form of delegation of management has been successfully developed. They are operated with some form of assistant manager, variously called manager, superintendent, foreman, etc. Such farms sometimes have departmental heads in addition. To be successful, however, such farms must have managers of unusual ability in organizing enterprises, in directing the activities of others, or in buying and selling and financing. No doubt our agriculture has thousands of such men who are not able to use their abilities very productively on small or middle-size farms. The lower limit in classifying farms as large-scale is best drawn at the point where the operator or manager no longer works with his men.

Part of the large-scale farms in the United States are single-unit enterprises with a central farmstead. Others are organized as chain farms, that is, with a series of farms in the same general locality each with a separate family living on it whose head may be called a hired manager or a tenant, differing from a plantation perhaps only in that its units are more widely scattered than those of most plantations. Still other variants are found in the Latin-American countries and elsewhere in the world.

Large-scale production plays a greatly varying role in different lines of production, ranging from 30 per cent of the total output for stock-ranches, in a classification made by Jennings from the 1930 census, to 20 per cent for fruit farms and also for truck farms, down to 3 per cent for dairy or poultry farms, and 2 per cent or less for cotton or cash-grain farms, plantation and chain farms not being included. This classification included all farms with $30,000 or more of product. This resulted in a high inclusion of fruit and truck farms because they have a high ratio of short-term expenditures to volume of sales.

The role of such farming also varies greatly by regions: in 1930, from 53 per cent of truck farming in California to 7 per cent in New York; and from 9 per cent of poultry farming in California to less than 1 per

TABLE 53. AVERAGE SIZE OF FARMS IN THE UNITED STATES BY CENSUS PERIODS, 1850 TO 1940, ACCORDING TO VARIOUS MEASURES

	All land (Acres)	*Land available for crops (Acres)*	*Workers — adult males (Number)*	*Productive animal units (Number)*	*Volume of agricultural products (1935–39 = 100) (Index numbers)*	*Gross value of farm products (Dollars of 1935–39)*
1850	203					
1860	199					
1870	153					
1880	134	71	1.45	10.8		
1890	136	78	1.37	12.6		
1900	146	72	1.27	13.3		
1910	138	75	1.30	10.8	79	$1,060
1920	148	78	1.29	11.2	91	1,320
1930	153	80	1.29	10.8	99	1,590
1940	174	88	1.24	14.2	106	1,830

groups include the 160's or full homesteads, the 80's or half homesteads, and the 40's and 20's, which are still the most frequent farm sizes in much of the country. In 1900, the 160's were clearly the most numerous, but by 1920 the 40's and 20's had taken the lead. Much of this was due to the increase in numbers of small cotton and tobacco farms in the South. In 1940, the 50–99-acre group gained the lead by a small margin. The decline in all of these modal groups has been made up for mainly by an increase in farms of from 3 to 9 acres and 10 to 19 acres. The size-groups above 175 acres have also become more important in the same period and especially since 1930. This latter shows mainly the effect of the tractor on family-size farms. The apparent stability in the average acreage per farm now appears to have arisen from two conflicting trends — toward more small farms and toward more large farms. Fewer middle-size farms is a necessary accompaniment of these two.

If these changes in size-groups were explored by regions, they would show that the shift toward larger farms is mainly explained by the large acreages required for ranching and other types of farming in territory west of the 100th Meridian, and the historical process of occupation of this region; and the shift toward smaller farms by the increase in part-

time and residential farms near our cities. The remaining principal factor in the situation is a trend toward larger family-size farms in the North Central divisions and in Oklahoma and Texas, as a result of increasing use of tractors and combines. The spread into the Great Plains was timed so as to counteract the breaking up of the plantations. The enlargement of farms due to mechanization was contemporaneous with the part-time farming movement. *It is unsafe to predict that similar*

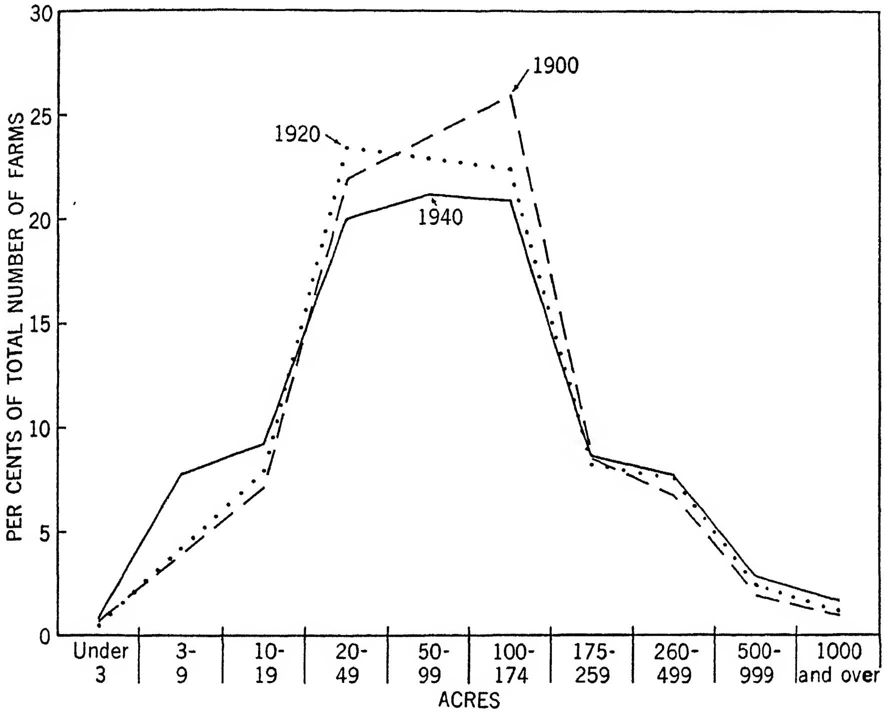

CHART 65. Distribution of farms by acre size-groups, 1900, 1920, and 1940.

timing will always occur in the future. The numbers of large farms have not increased in the country as a whole in recent decades. Only 2.4 per cent of the farms had $6,000 or more of products in 1940 as compared with 3.7 in 1930. (Farm products were a third lower in price in 1940.) The number of so-called "factory farms" may very well increase, however, in certain lines of production with high risks that lend themselves to standardized methods. Group or chain farming may increase also. Increase in the number of " economic units " in the South may raise the average size in that region.

FURTHER READING

G. Alvin Carpenter, *Farm Size in California*, U.S.D.A., BAE, Berkeley, California, 1940.

Louis J. Ducoff and Margaret Jarman Hagood, *Differentials in Productivity and in Farm Income of Agricultural Workers by Size of Enterprise and by Regions*, U.S.D.A., BAE 1944.

D. Curtis Mumford, *Large-Scale Farming in the United States*, U.S.D.A., BAE, 1933.

Walter L. Ruden, *Farm Size and Its Relation to Volume of Production, Operating Costs and Net Returns — Southeastern Nebraska, 1930–1939*, Nebraska Bull. 346, 1943.

EXERCISES

1. How does the average farm in your state compare in acreage, number of persons employed, and value of output with the average farm in the United States? Discuss the factors responsible for farms in your state smaller or larger than the national average.
2. Do the same for farms in your county compared with farms in the state as a whole.
3. Estimate the average annual inputs for your home farm, or for a farm with which you are familiar, and contrast the results with the farms presented in Table 51. How does it compare in other factors as well?
4. Determine the amount of capital required to start farming on a typical farm in your community.
5. On this same farm, how might its "size" be increased without changing its acreage? Under what circumstances would it pay to take one or more of these steps, and under what circumstances would it pay to add acreage?
6. What has been the trend in farm size, as measured in acreage and also in any other measures for which data are available, in your home county?

CHAPTER XX

Adjusting Farm Production to Markets and Prices

THE NEXT SECTOR IN THE BODY OF PRINCIPLES THAT MUST BE MORE fully stated and better integrated is that which relates to the farmers' problems of adjusting their production programs to the various types of changes that were defined in Chapter VI — trends, cycles, episodes like new inventions and changes in consuming habits, or depressions and wars, and finally the longer sweeps of history. We shall approach the subject in this chapter from the standpoint of the adjustment of farming to changing markets and prices. These may arise from causes within agriculture, such as developments in technology, or pest and disease visitations, or above all, the weather. But the more perplexing ones impinge on agriculture from without. The first part of the chapter will try to state the nature of the problem. The simple fact is that agriculture does not adjust itself to markets and price as does industry. We need to see why this is. The second part will try to present methods by which agriculture can make better adjustments.

THE BASIC THEORY OF ECONOMIC ADJUSTMENT

We shall begin our analysis by calling to mind the elementary principles of economics that are involved in our problem. Unless we do, we shall not all start together on a common ground of understanding. Most of this body of principles has already been called into use in earlier chapters. All that is needed here is to integrate it in terms of the problem now before us.

EQUILIBRIUM PRICE Thus in Chapter XVI, we considered some actual cost curves for a group of five dairy areas competing for a common market. Insofar as these curves properly represented the dairy farms of these areas, they were in effect the composite supply curves for the dairy producers supplying the New England market for cream and milk. Then in Chapter XVII, we considered some actual marginal cost curves for individual Los Angeles milk producers and Aroostook

potato producers. We saw how these individual producers match marginal costs and selling prices in determining the volume of output that yields their highest returns or revenues. We did not at that stage take time to combine the individual cost curves of all the competing producers into one composite cost curve. If we had, we might have had a curve something like SX in Chart 66. At low prices, say $.25 a bushel, only a few low-cost producers would supply any potatoes at all, and even these would not expand their output much before reaching their highest-profit points. At $.50, these producers would supply more, and many more farmers would find producing some potatoes profitable. At $1.50 a bushel, probably all potential producers would be brought into production, and the low-cost producers would devote every available acre of land to potatoes. The second column in Table 54 gives the amount which the potato producers would supply at various prices according to the Curve SX.

TABLE 54. AMOUNTS OF POTATOES THAT PRODUCERS IN THE UNITED STATES WILL SUPPLY, AND CONSUMERS WILL USE, AT PRICES RANGING FROM $.25 TO $1.50 PER BUSHEL. (HYPOTHETICAL BUT ROUGHLY IN ACCORD WITH THE FACT OF THE SITUATION.)

Price per bushel	*Amount supplied (million bushels)*	*Amount demanded (million bushels)*
$1.50	700	250
1.40	600	260
1.25	500	280
.90	400	320
.70	350	350
.50	300	400
.25	200	500

Nothing has been said in these earlier chapters about demand curves as such in explaining volume of output. In each situation, various levels of selling prices were assumed and the effect on output observed. We now need to think of the factors determining prices, and this calls for a consideration of demand. Consumers have a wide range of urgencies of needs and desires for farm and other products, just as producers have a wide range of costs. At a low price — $.25 a bushel, let us say — all the potential buyers come into the market and buy freely. At $.50 some of the buyers may drop out of the market — for example, those who buy potatoes for starch-making — and others restrict their pur-

chases a little. At very high prices — $1.50 a bushel, let us say — a large fraction of them restrict their purchases. All of these demands put together make the composite demand Curve DY in Chart 66, the data for which are in the third column in Table 54. The market price is at M or $.70 per bushel, the point of intersection of SX and DY.

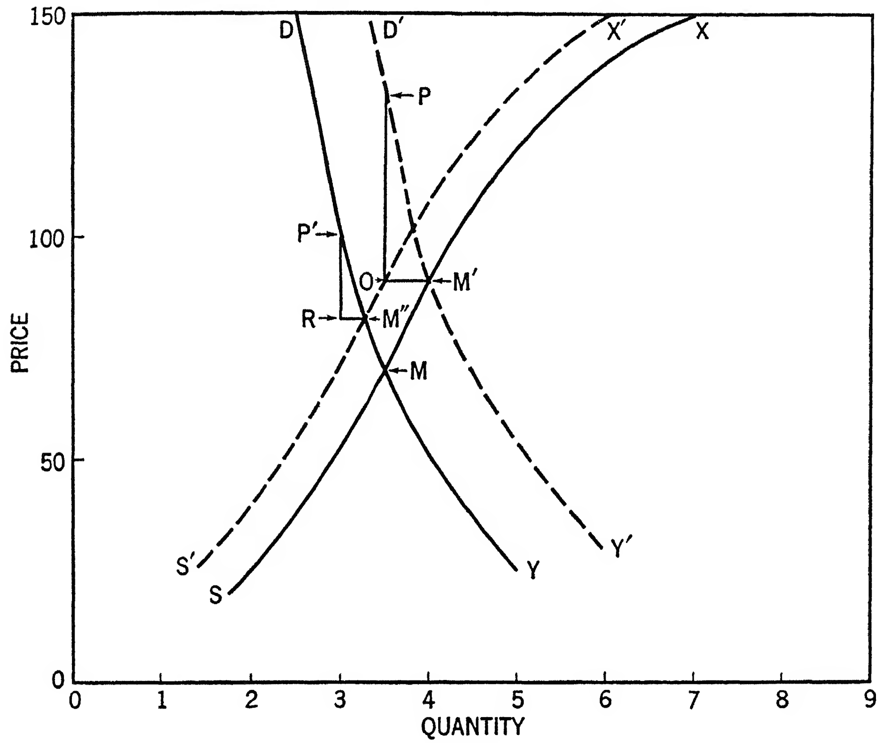

CHART 66. Supply and demand curves, and equilibrium price, for a hypothetical self-contained potato market. (The supply curve is drawn convex toward the top because the acreage of potential potato land is usually large in most areas; if the price were high enough, the production would be huge.)

The consumption at prices lower than $.70 is thus cut off, and likewise the potential production at prices higher than $.70. If this is a purely competitive market — and most agricultural markets are purely competitive or almost so — all farmers must sell at this equilibrium price of $.70 if they are to sell at all; and all buyers must buy if they buy at all. At the equilibrium price of $.70, exactly 350 million bushels of potatoes would be produced and bought.

Demand of course is not fixed. If it increases, perhaps because of a wartime demand for export, this means that buyers stand ready to buy more at the various prices in Chart 66. The demand curve would shift to the right — to D′Y′ perhaps. If costs remain the same, the price will rise to M′, or \$.90 a bushel, and output would increase from 350 to 400 million bushels.

If, on the contrary, costs were to rise — perhaps because diseases got the better of the plant pathologists for a while, so that producers were able to produce fewer potatoes at the various prices, the cost curve might shift to S′X′ and the price to M″ or \$.80; and production would decline to 300 million bushels. An improvement in technology that reduced costs might, contrariwise, shift the cost curve to the right, lower prices to \$.50 a bushel, and raise production to 400 millions.

The assumption thus far is that producers change their output immediately, that they contract their production at once if costs rise, and expand it if costs fall; and that demand responds equally promptly. In fact, it usually takes producers at least a year to respond to increased demand. While production is thus lagging, prices will rise to more than the \$.90 per bushel. Similarly, it is likely to take consumers a few years to change their eating habits to take advantage of the lower prices of potatoes, and prices would drop below \$.50 for a time if the cost curve shifted to the right and production rose to 400 million bushels. A set of cost and demand curves which show the location of the equilibrium price M in either of these cases is called a *short-run* curve. The curves in Chart 66 are really *long-run* curves — they show what production, demand, and prices will be after time enough has elapsed to enable producers and consumers to make their final adjustments. Between these two curves may be all sorts of *middle-run* curves, showing the responses and equilibrium prices in two or three years perhaps, but not long enough for final adjustments.

In practice, of course, such long-run curves may never be realized — costs and demand may change so frequently that the adjustments never quite catch up with them. The uncertainties of yields and employment contribute greatly to such failure of adjustments ever being completed. In real life, most of such sets of curves are therefore of the middle-run type.

ELASTICITY OF DEMAND The slope of the demand curve obviously affects greatly the amount of change in price that will accompany a change in demand. The demand curve in Chart 66 is *inelastic*. This means that the demand changes less than the price. A demand curve in

which they change in exact proportions is said to have *unit elasticity.* Price × Quantity gives a constant value of product, or *Total Revenue,* with such a curve, as indicated by the middle curve in Chart 67, and the middle section of Table 55. The reader will note that the crop sells for $245 million regardless of its size because price goes up exactly as fast as quantity goes down, and vice versa. With the inelastic curve, data for which are given in the first section of the table, a small crop

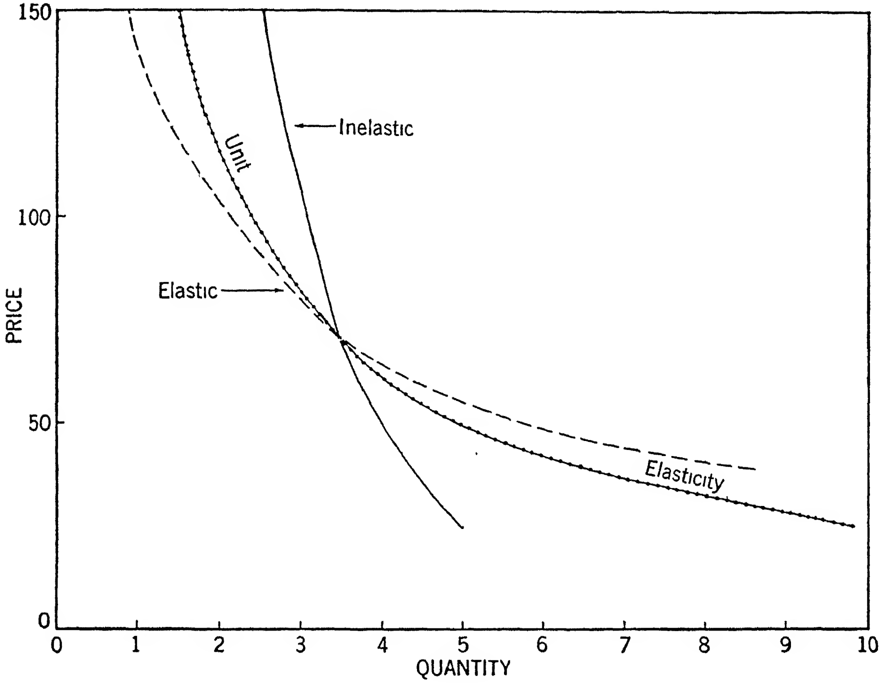

CHART 67. Elastic and inelastic demand curves, and curve of unit elasticity.

sells for more than a large one. With an elastic demand curve, the larger crop brings the higher revenue. Farm products with inelastic demand curves are potatoes, milk, cotton, and all meats combined; with elastic demand curves, butter, cream, and beef.

MONOPOLY ELEMENTS Just one other strand needs to be woven into this fabric to give us the working basis we need for the analysis in this chapter. Should the producers of a product be in a strategic position and able to keep themselves from responding to increased demand and higher prices in the usual way, they could increase their gross and net returns *if the new demand curves for their product were inelastic — not otherwise.*

TABLE 55. DATA FOR CHART 67, WHICH SHOWS ELASTIC AND INELASTIC DEMAND CURVES AND A CURVE WITH UNIT ELASTICITY

Price	*Inelastic*		*Unit elasticity*		*Elastic*	
	Quantity (millions)	*Revenue (millions)*	*Quantity (millions)*	*Revenue (millions)*	*Quantity (millions)*	*Revenue (millions)*
$1.50	250	$380	150	$245	90	$150
1.40	260	370	160	245	106	175
1.25	280	350	180	245	130	210
.90	320	288	270	245	250	225
.70	350	245	350	245	350	245
.50	400	200	490	245	575	260
.25	500	125	980	245		

If they could stop the response altogether, they would get a price of P (Chart 66), or $1.25, for the 350 million bushels, or a total revenue of $435 millions, instead of the $360 million from selling 400 million bushels at M′ or $.90. This is because the vertical leg of the triangle M′OP is longer than the horizontal leg, price increasing faster than quantity decreases.

Similarly, the buyers of farm products, if in a strategic position, could spend less money on potatoes than otherwise if they could keep themselves from bidding up the price as costs rose, again if the demand curve were inelastic and *not otherwise*. If they could check the price rise altogether, they would spend $210 millions for potatoes — 300 million bushels at $.70, instead of $275 millions for 335 million bushels at M″ or $.82.

This is because the price leg of the triangle M″RP′ is longer than the quantity leg. With no more potatoes produced than 300 million bushels, the actual consumers would bid up the retail price to the P′ level, or $1.00 a bushel. In this case, the buyer-dealer group would reap monopoly gains of $.30 per bushel. This kind of buying by dealers is now called *monopsony* in the textbooks. To gain from monopsony, it is not necessary that the buyers check price rises completely when supplies fall off or consumer demand increases. Any degree of success whatever would add to that extent to their revenues. A limited amount of monopsony prevails in a few farm product markets.[1]

Neither is it necessary that producers check completely the response

[1] For a full discussion of this, see William H. Nicholls, *Theoretical Analysis of Imperfect Competition with Special Application to the Agricultural Industries*, Ames, Iowa State College Press, 1941.

of production to rising demand and prices. Any degree of success along this line would add to that extent to their revenue. Groups of producers here and there have achieved a limited success in such efforts. Ordinarily the assistance of the government is needed to effectuate such a program. The A A A, however, made only small headway in 1933–1941 — yields increased about as fast as acreage was reduced.

To show what volume of output will give monopolistic producers the highest revenue, economists now usually construct a diagram showing how total revenue changes with different combinations of quantity and price, and also how the *marginal* or *additional revenue* declines. At the point where additional revenue just equals additional expenses, the producers obtain the highest *net* revenue, or highest profit. The location of this point of course depends upon the elasticity of the demand curve and also the slope of the cost curve.

The demand curves shown in Charts 66 and 67 have about the same elasticity throughout their courses. Most actual demand curves have different rates of change at various price levels. Commonly they shift from inelastic to elastic, or the reverse, near their top. Thus, the inelastic demand curve for potatoes shown in Charts 66 and 67 may very well, at around $1.25 per bushel, begin to take the slope of the elastic one — bread, corn, and rice being substituted increasingly for potatoes as the price rises above $1.25. The substitution of margarine for butter above a certain price level makes the butter demand curve much more elastic in the higher reaches. These changes in slopes of demand curves put a definite check on possible monopoly gains.

A common practice employed by manufacturers is to attempt to create a special demand for their product by *product differentiation* and the use of brands and advertising. To the extent that they are successful, they are able to sell more of their product at the prevailing price, or the normal amount at a higher price, or work out some combination of these two. They can easily set the price too high and reduce their net revenues.

Farmers producing purebred animals or special brands of products may realize some gains in this way. They, too, must consider the volume of their sales at different prices. There is a limit to the number of purebred boars that a farmer can sell at $75 each, or the number of dozen of eggs that he can sell at a premium of 15 cents over the usual market price. Under such conditions, farmers must balance their marginal costs and their marginal revenues. The combination of price and volume of sales which they seek is that at which marginal cost equals marginal revenue.

THE WORKING OUT OF THE BASIC PRINCIPLES IN AGRICULTURE

The general body of principles of economic adjustment as above outlined is not highly useful in understanding the adjustment problems of agriculture until it is adapted to circumstances and conditions in agriculture. The particular characteristics of agriculture that are important in this connection are the following:

1. As stated above, conditions of pure competition prevail generally. Most staple farm products are all in one big market, even a world market in the case of nonperishables. Prices in the particular market to which farmers deliver their products are closely tied to those in other markets. (They are least closely tied in the case of fresh vegetables, fruits, eggs, and milk in some Southern markets.) Aroostook may have a big crop of potatoes when the crop is short elsewhere and prosper exceedingly that year; contrariwise, the New York dairymen may have a short hay crop and pasture when feed is abundant elsewhere and therefore be forced to produce at a very low price unless their cooperative can get prices temporarily raised out of line with other markets.
2. The total revenue curve for some farm products rises with increasing domestic output and for some not, depending upon how large a part of the world supply our production is and upon the elasticity of the demand curve of the product. It has in the past been a rising curve for wheat, beef, lamb, sugar crops, wool, flax, and most dairy and poultry products except fresh milk, and a declining curve for cotton, most tobaccos, potatoes, and possibly pork and lard. For all farm products combined, big crops sell for more than small crops unless we lose too much of our foreign markets. We had almost done this in 1930–1940.
3. The cost and supply curves for a majority of farm products, and especially for all combined, rise rather sharply in the short and middle runs. This means that if the demand increases importantly, as during the war, prices rise much, but fall sharply when demand falls off in a depression. In the short run, a change of 5 per cent in the combined demand for all farm products may move prices up or down by twice this amount. The reason for this steepness of the short-run and middle-run supply curves is commonly expressed by saying that agriculture is "affected by increasing costs" as compared with the "decreasing costs" in industry. It is true that agricultural production

increased at least by a fourth from 1940 to 1945, but manufacturing more than doubled in the same period. The increase of one fourth was possible only because of the large reserves of unutilized productivity on our farms resulting from the prolonged 1920–1940 agricultural depression and from the soil-improving programs of 1935–1940. The short-run increases in supply must come mainly from using more fertilizer and from shifting to more intensive crops. Livestock products can be increased quickly only if reserves of feed are on hand or if the weather is unusually favorable for corn and other feed crops. Both of these were true in 1942–1943.

4. A particular reason for the sharp short-run decline in prices of most farm products with falling demand is the perishability or high cost of storing them.
5. The long-run increases in the supply of farm products require new capital investments the same as in industry — in land improvements, farm buildings, expanding livestock herds, and in improving methods of production.
6. Once agricultural production has expanded, it contracts very slowly, if at all. Agriculture as a whole in the United States really never has contracted, with the possible exception of 1933 to 1935. If output in any year has been less than in the year just before, adverse weather has been the reason for it. The index numbers of physical volume of agricultural production were 93, 91, and 94 in 1934, 1935, and 1936, compared with around 100 in 1928–1932, but 106, 103, and 104 in the years following.
7. Outputs of some particular products, for other reasons than bad weather, however, contract sharply in a year or two. This is notably true of eggs and poultry, hogs, crops like cotton and potatoes, and commercial vegetable crops like cabbage and onions. Many have mistakenly reasoned from this contractibility of individual products that farm production as whole contracts when prices fall.
8. Farmers do not respond to changes in demand in a very rational manner. Instead, they tend to be influenced by the prices received in the preceding year, or those prevailing at planting time without regard to the fact that they may be high or low because of poor or good weather or some other unusual circumstance. Weather effects on prices appear to conceal from farmers the effects of changes in demand.
9. The production cycles described in Chapter VI appear to be the combined result of the failure of farmers to respond rationally to changes in demand and of the time required to contract and expand

production. The cycles are longer for cattle than for hogs because of the longer time it takes to expand herds. If only this were involved, however, they would be much shorter than they are.

10. Although cotton, wheat, potato, sugar, and other one-crop farmers may reduce their acreage for a year or two when prices have been low, they do not usually go farther if the low prices continue. The result is that surplus conditions may persist for a decade or two — witness cotton, wheat, and tobacco in the 1930's, and cotton still.
11. That agriculture does not contract much in a depression is evident from the data in Table 56 which compare agricultural and seven other outputs in the depression of the 1930's. The main reasons for this have already been given under the preceding ten heads. The most important single reason is not specifically stated; it is that farmers are not in a position to stop producing when prices break, as are most manufacturers. They may have production under way that must be carried through to the harvest, or until the animals are ready for slaughter; or the only way to market their feed crops may be through their herds. If they do not feed them, they will not have room to store the next crop. They cannot very well let their land grow up to weeds. Also, what work would they find to do if they did not plant and harvest another crop? The manufacturer can

TABLE 56. PHYSICAL VOLUME OF OUTPUT FOR AGRICULTURE AND SEVEN OTHER LINES OF PRODUCTION IN 1929–1938

Year [a]	*Agriculture*	*Mining*	*Electric light and power and gas*	*Manufacturing*	*Construction*	*Steam railroad transportation*	*Street railways*	*Telephone*
1929	100.0	100.0	100.0	100.0	100 0	100.0	100 0	100.0
1930	100.0	88.6	98.2	84.5	83 3	85.7	89.2	98.3
1931	105.9	75.3	94.6	72.5	62 9	69.3	80.8	94.3
1932	98.9	62.0	84.7	55.7	32.0	52.6	68.8	84.5
1933	96.0	67.1	85.5	62.4	27.7	55.1	64.6	78.6
1934	91.0	72.7	91.2	67.1	30.9	59.7	68.1	87.1
1935	89.0	78.2	94.2	78.9	35.7	62.4		
1936	92.0	90.0	113.4	94.3	53.1	75.2		
1937	103.7	101.8	120.2	102.4	57.0	80.3		
1938	100.8	88.1	110.2	78.9	61.8	65.3		

[a] The index numbers for 1929–1934 are based on Simon Kuznets, *Income Originating in Nine Basic Industries*. National Bureau of Economic Research, Bull. 59, and for 1935–1938 were derived from the *Statistical Abstract*.

shift the employment problem over to his employees, stop buying raw materials and fuel and wait till prices cover his marginal variable costs at least.

Farmers are even accused of expanding their production at times to offset the lower prices. This actually does happen on some farms hard pressed to meet tax and interest payments. It often takes the form of adding a new supplementary enterprise, such as a canning crop.

Another factor in the situation, of course, is that some of the farmer's input factors decline in price so that he can afford to keep on using them. This commonly is true of hired labor — by 1933, farm wages were down a half from 1929. Feed prices may presently fall to a level at which farmers get more for their feed by feeding it than by selling it for cash.

Even reducing fertilizer consumption may not give quick results. Commercial fertilizer consumption in this country declined from 8.2 million tons in 1930 to 3.0 in 1931 and 4.4 millions in 1932. Yields of cotton and tobacco, which used one half of this supply, fell off not at all in 1931, and only a little in 1932.

A less important factor in the keeping up of agricultural production in depression is that a fraction of it is production for the use of the farm families.

METHODS OF ADJUSTMENT TO CHANGING DEMAND AND PRICES

The first requirement, if farmers are to adjust their production better to demand and prices, is that they recognize better than they now do the changes that have already taken place, those that are now in process, and those that are in prospect. This means that they must understand better why prices are behaving as they are at any given time, what part changing demand is playing in it, what part changing supply, what part production cycles, what part changes in the general price level, etc. They need to make good judgments as to what the prices would have been the past year if yields had been average, or if business had been normal, or price levels or exports normal, and as to what business, price levels, and exports will be like in the coming year. They need to know at what points their products are in the production cycles, if they have any, and to know the direction and strength of trends caused by new developments.

This need was well expressed by Henry A. Wallace in his book *Agricultural Prices*, published in 1920. He said that farmers must be able

to "*judge* prices better."[2] Not long afterwards, his father, Secretary of Agriculture Henry C. Wallace, authorized the preparation of the first "outlook report," the major emphasis of which in the first few years was on interpreting the general demand situation.[3] Presently separate statements were prepared for each farm product; and these statements were carried back to the states following the national outlook conference, and thence out into the counties. The states did a great deal of extension work along these lines from 1928 until 1933 when the A A A type of adjustment program replaced it increasingly; and finally the wartime production goal programs replaced the A A A types of adjustments.

The farmers are now again in a position where they need to judge prices and adapt their production to any real changes in demand and supply that have taken place. The individual farmers cannot do this unaided because they do not have access to all the pertinent facts, nor all the tools of analysis needed. As is explained more carefully in Chapter XXXV on "The Role of Public Agencies in Farm Management," to provide farmers with these facts, and to make any analysis of them that will be helpful, is one of the major functions of government with respect to agriculture.

Adjustments of agricultural production to its demand and prices will improve about as rapidly as the farmers adopt the practice of deliberately planning their production at the beginning of each crop year. In making these plans, they must use prospective, not current or past, prices for the different products, wages of hired labor, and prices of fertilizers, feed, and other supplies. If they exercise good judgment in deciding what prices to use, their production will become much more responsive than it is now. They must, of course, have the necessary data as to operations on their farms if they are going to make plans. Later Chapters, XXVIII and XXIX, discuss farm planning in considerable detail.

Perhaps it needs to be stated again at this point that such planning of the farm business from year to year does not mean continuous and frequent changes in the farm program. The basic elements in a farm program should be changed only after two or three years of deliberation and study. But a time may come when a farmer in northern Illinois who has been marketing his feed through hogs and beef cattle will find it wise to substitute Holsteins for Shorthorns; or a cash-grain farmer to shift toward feeding out most of his grain. Most of the year-to-year responses are less drastic than this, but still enough so that if other

[2] *Wallace's Farmer*, Des Moines, Iowa.

[3] *First Outlook Report*, April, 1923.

farmers do the same the total supply is markedly increased or decreased.

It should be obvious that each farmer should decide what adjustments to demand and price are best on his farm. The most that extension workers can do is supply them with the facts and interpretations, teach them how to set up farm budgets, how to test various alternative adjustments and choose the most promising one, and perhaps figure out for them the adjustments called for under some of the more common situations on farms in their counties. They can also teach farmers how to keep records so that they supply the data on their own farm operations that they need in testing out alternatives and in balancing additional outlays against additional income.

At one time or another, public agencies have gone so far as to forecast the prices to be expected. It is now generally believed that this is too great a responsibility for any public servant to assume. Or it is being said instead that if the government is to forecast a price, it almost has to see that the price is realized. Hence, there is much support these days for the proposals that the government name the price before planting times, and before breeding time in the case of livestock, and then guarantee this price.[4] There can be no doubt that farmers would soon learn how to make much better adjustments if this program were adopted. The government would, however, be assuming a larger share than before the war in deciding what over-all adjustments are needed.

ADJUSTMENTS BY TYPES OF FARMING

The nature of the problem of adjustments in production to meet changes in demand and market prices varies with the product and with the type of farming. Possible adjustments are at a minimum on highly specialized one-crop farms and at a maximum on the diversified and general farms. If prices are low, about all that specialized farms producing one crop such as potatoes or sugar beets can do is reduce their fertilizer use; or in some cases, decrease expenditures on cultivation. In extreme cases, they may leave part of the crop unharvested, thus reducing cash costs. If the low prices are anticipated at planting time, it may be possible to seed a part of the land to a soil-building crop and have it ready to produce an even larger yield in the following year. On farms specializing in livestock products, expansion is limited in the short run by the farm's feed supply, or by the rather sharp rise

[4] T. W. Schultz, *Redirecting Farm Policy*. New York, The Macmillan Company, 1943.

in the marginal-cost curve. With prices falling, the rate of feeding can be reduced, but the output falls off relatively slowly. More results can be obtained by culling. Chart 68 shows that beef-cattle raisers have expanded and contracted their herds a great deal in the past along with price changes, usually with a lag of three or four years, however.[5] Lack

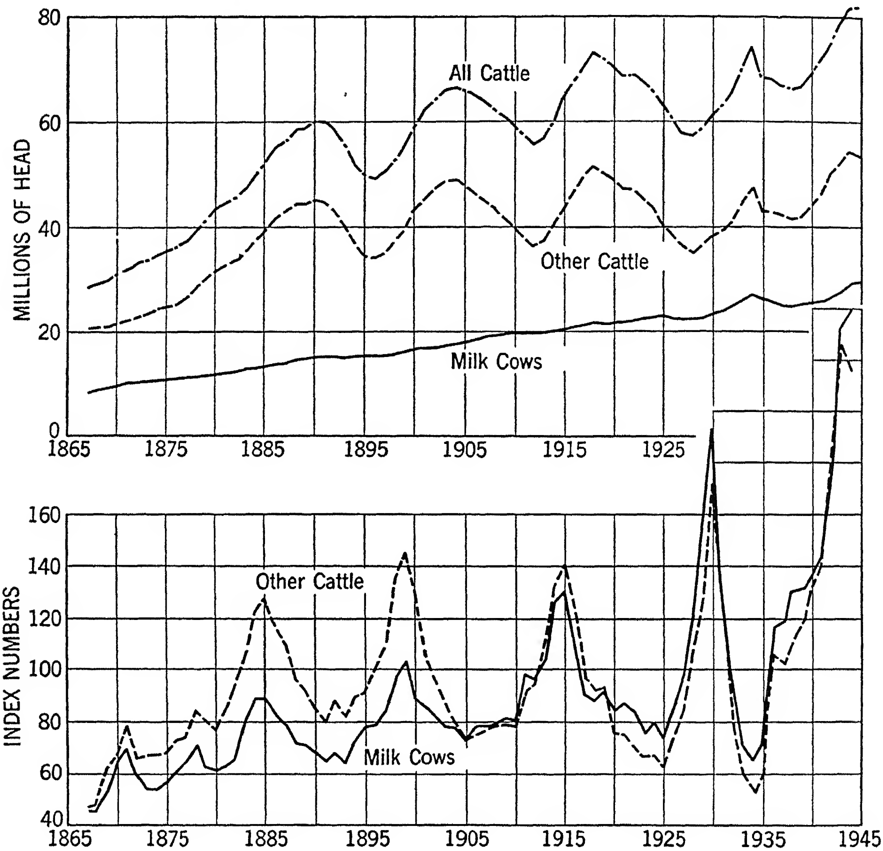

CHART 68. Numbers of all cattle, "other cattle," and milk cows, and prices of cattle at Chicago, 1900–1944. (Reproduced from Agricultural Outlook Charts, 1946, p. 78, and from data in *Agricultural Statistics*, 1945.)

of feed on the range was an important factor in causing the reduction of cattle numbers in a few years, but most of the changes can be related to price trends.

Farms that fatten beef cattle have more flexibility than the cattle ranches. As explained in Chapter XII, they can vary the length of the

[5] The prices of cattle started downward in 1900, and numbers of other cattle did not decline until 1904; and similarly in 1915–1919, and 1930–1934.

feeding, the proportions of grain and roughage used in the fattening ration, the time of the year when the cattle are purchased and sold, and the age and weight of cattle fed. Years of wide margins between feeder-cattle and finished-cattle prices and of low prices for grain favor feeding heavy cattle to a high degree of finish. High grain prices and narrow margins favor feeding calves. Low-quality cattle fed large quantities of roughage relative to grain and sold without a high degree of finish usually return higher profits to the feeder when margins are narrow. A study of market statistics indicates, however, that the bulk of the cattle feeders have not taken good advantage of these opportunities. They seem to have responded to current prices as though they expected them to continue. Thus, following a year of wide margins, they have often sharply increased the feeding of heavy cattle to a high degree of finish, and as a result, prices of finished cattle have dropped relative to feeder prices and the year has proved to be one of below-average margins. Only a few of the better cattle feeders analyze the movements of feeder and finished cattle in such a way as to make advantageous yearly adjustments in their cattle-feeding operations.

In the familiar movements in hog numbers, prices and the hog-corn ratio, shown in Chart 69, the fluctuations in the corn supply seem to play a larger role than prices in the increasing and contracting of hog numbers. Hog numbers increase to consume large crops of corn, and contract afterwards. Prices change with the numbers of hogs marketed. But there is evidence in the chart of response of hog numbers to prices also. Hogs perform a sort of balancing function on feed-livestock farms.

Opportunities for adjustment to varying prices are much greater on general farms. Acreages of specific crops and numbers of dairy cows, chickens, or pigs, can be increased or decreased as relative prices change, and of course, the amount of labor hired and feed purchased may be varied from year to year depending on the price ratios. Large adjustments in major enterprises, *i.e.*, increasing or decreasing enterprises by one third or one half or more, are justified, however, only on the basis of unusual circumstances on the farm or a change in long-time plans. Farmers who make changes of this magnitude in an attempt to capitalize on expected price changes are often called "plungers" by their neighbors and usually suffer severe losses as a result of mistaken decisions which soon wipe out their gains.

An important part of the educational program in the production and marketing of the various farm products such as poultry, eggs, butter, hogs, and beef cattle, has been that dealing with the formulation of production plans which result in having the bulk of the product

ready for market at the time when high seasonal prices usually prevail. The study of the practices of the more successful farmers usually shows that they are achieving this objective. But it is always possible to produce for these high-priced markets at an increase in cost which is more than the increase in price. Probably only the more successful farmers

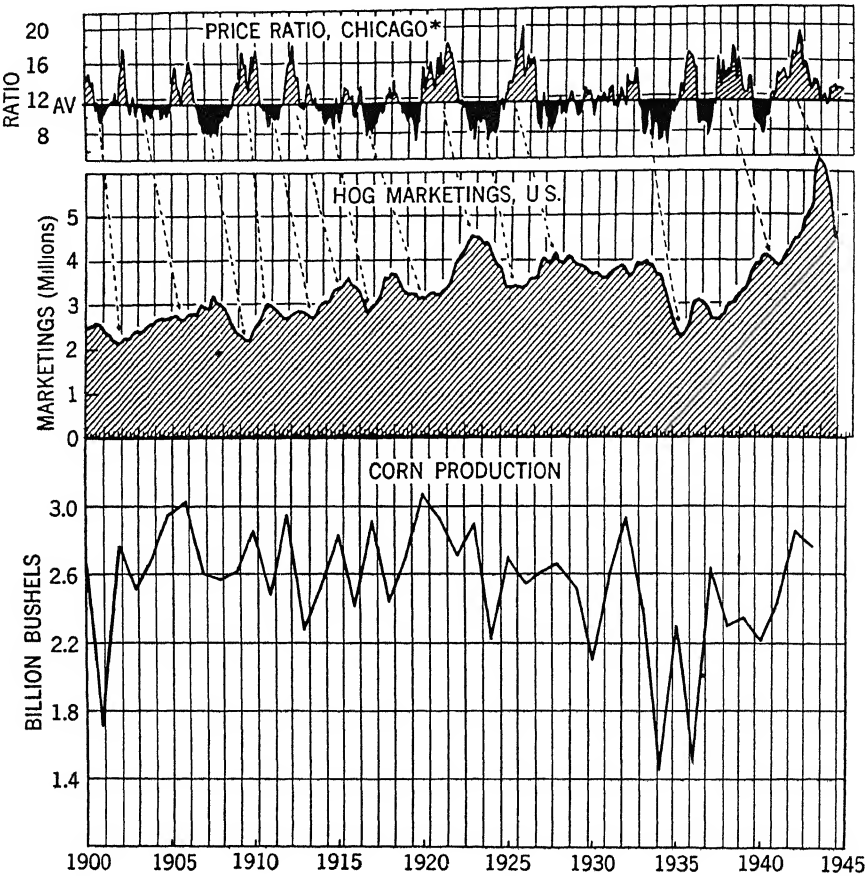

CHART 69. Hog-corn price ratios, hog marketings, and corn production, 1900 to date.

who feed the better rations, who have the better-bred livestock, and who house and care for them better than the average farmer, can obtain "out-of-season" production at low enough costs. Also, anything like a general shift in the seasonality of production would not only level out seasonal variations in supplies and prices, but increase the over-all production costs for this line of production as well. As mentioned earlier,

however, with continued technological developments we can expect a continued leveling out of seasonal production and prices.

ADJUSTMENTS IN LOCAL MARKETS

The foregoing discussion of adjustments has mostly assumed production for a nation-wide or international market. Any city is more or less of a local market for fresh vegetables and fruits in season, fresh eggs, fresh-killed poultry, fresh milk, and even fresh cream. The premium which consumers would pay for some of these if they had to is very large. For example, during the war, local strawberries in season sold in many northern markets for twice the prices of southern berries a month earlier, and local sweet corn sold for 10 cents an ear in the first week of the 1945 season. They do not usually rise to these levels because local producers ordinarily supply these markets amply while the season lasts. The local producers have these markets to themselves, in whole or in part, in some cases because of the premium on freshness, in part because of shorter hauls and savings in transport, and in part because of savings in refrigeration and storage costs. They sometimes lose them partly because they do not produce as good or as standardized a product as outside areas, because of the higher costs of local production, or because of technological developments like quick freezing.

Given such a local market, the problems of adjusting production to it are often difficult. With milk, these difficulties have led to the setting up of the milk cooperatives and to forms of organized control described in Chapter XLII in PART FIVE. With eggs, as long as a local market is on a deficit basis, local production can expand at will. But many local markets in the Northeast have passed that point and are now on a surplus basis some of the time. This means sharp breaks in prices at some seasons. Vegetable production tends to be erratic in local markets. Spinach or kale production around Washington or Richmond may be a half more than consumers will buy in some years, and as much below average in other years; similarly with strawberries around Midwestern cities, and green beans and squash in Northeastern markets. The farmers who grow truck crops regularly as their sole source of income tend to adopt certain production programs and adhere to them year after year. But most markets have many "in-and-outers" who are tempted to expand following a year when they have done well on a small acreage of some crop. This group in particular needs production plans worked out on the basis of average prices and outlays.

Another type of situation is that in which local producers are not supplying as much local produce as the consumers in the area could advantageously use. The rise in freight rates following the First World War gave new advantages to the local production of many vegetables and fruits, but the farms around many Northern and Eastern cities were slow to sense this. In some cases, the cities have grown faster than the local supplies because the local production zone has not expanded as it needs to. In many cases, the local producers have not yet learned the necessary techniques of production. In such a situation, the first step is for the area to obtain needed facts about consumption, supplies, and prices.[6] The second is to use these facts in planning farm production programs.

PRODUCING FOR SPECIAL MARKETS

The usual producer of industrial goods tries to secure a more or less special market for his product by giving it a brand name and spending a good deal in advertising and selling. Around most cities, especially the small and middle-sized ones, there are opportunities of this kind for a small number of producers of eggs, dairy products, vegetables, and occasional other products. A limited number of individual farmers can also advantageously undertake to develop wider outlets through mail-order selling or other sales devices. The opportunities of this latter sort will be for unusual types of products. Farmers generally make more headway in developing special markets through cooperative endeavor rather than through individual effort. This subject will receive further attention in the chapter on "The Management of Buying and Selling."

FURTHER READING

* J. K. Galbraith and J. D. Black, "The Maintenance of Agricultural Production during Depression: the Explanations Reviewed," *The Journal of Political Economy*, June, 1938, pp. 305–323.

* United States Department of Agriculture, Bureau of Agricultural Economics, *Agricultural Outlook Charts*, Washington. Published each year in November.

[6] Studies that more or less meet these needs are the following: H. C. Woodworth, L. B. Lincoln and H. I. Richards, *Can New Hampshire Produce What She Eats?* New Hampshire Bull. 222, 1926; C. H. Merchant and B. T. Smith, *Local Market Requirements of Agricultural Products in Aroostook County, Maine.* Maine Bull. 355, 1930; J. H. Blackstone and B. T. Inman, *Food Habits of Consumer Groups in Small Towns of Alabama That Affect Farmers' Markets.* Alabama Bull. 252, 1942; R. F. Burdette and W. P. Walker, *Where Frederick and Salisbury, Md., Get Their Food Supplies.* Maryland Bull. A–11, 1942.

John D. Black, *Parity, Parity, Parity*, The Harvard Committee on Research in the Social Sciences, 1942, Cambridge, Massachusetts, pp. 125–144.

*D. R. Mitchell, *How Farmers Adjust When Prices Fall.* Wisconsin Bull. 431, 1935.

*L. J. Norton, *Prices of Illinois Farm Products from 1921 to 1929.* Illinois Bull. 363, 1930. Also Bull. 422, 1935.

*W. C. Waite and R. W. Cox, *Seasonal Variations of Prices and Marketings of Minnesota Agricultural Products, 1921–1935.* Minnesota Bull. 127, 1938.

EXERCISES

1. What changes in acreage of an important crop, or in numbers of some type of livestock have occurred in your county or state in the past thirty years? Were these changes made in response to price changes? Or to what other factors?
2. On your home farm, or on one with which you are familiar, what adjustments could profitably be made if you were sure that the price of your chief commodity would increase 10 per cent during the next 6 months only? If you were sure that prices would rise 10 per cent at the end of 6 months and remain up for 2 years? If you were sure that prices would rise 10 per cent, in relation to prices of other agricultural commodities, over the next 2 or 3 years and would remain indefinitely at this favorable level?
3. Similarly, what adjustments could profitably be made if price decreases rather than increases were expected?
4. How far would these decisions be modified if you were fairly sure but not certain of these relationships, and if there are some costs involved in making these adjustments?
5. At what season of the year has the bulk of the main product been sold on your farm? How did the price received compare with the highest level for the year? Would your farm have had a larger income if sales had been planned for the high-price period? Why or why not?
6. Make a chart of the monthly average price for the two most important farm products in your area for each of the last three years. Are the annual price patterns sufficiently similar to justify adjustment of production and marketing plans to them?

CHAPTER XXI

Farming Costs

THE PURPOSE OF THIS CHAPTER IS TO SHOW WHAT KINDS AND FORMS of cost figures are needed for the different uses which such figures serve. That cost data of one kind or another are essential in obtaining the answers to a large number of questions of farm organization and operation, is very evident in the earlier chapters. But the form in which the data are needed varies with the use. Cost data are also sometimes used for other purposes, such as setting prices, but these uses are mainly outside the scope of this book.

FORMS AND KINDS OF COST DATA

The forms which cost data take may be distinguished as follows:

1. Marginal versus average costs — explained in Chapter XVII.
2. Combined or total costs versus single-input costs like feed costs or labor costs — also explained in Chapter XVII.
3. Combined costs are also referred to as *unit* costs. But unit costs may be *per unit of output* or *per unit of some input factor*, such as per acre of land, per horse, per cow, etc. In the literature on farming costs, unit costs usually mean costs per unit of output unless otherwise specified.
4. Physical costs versus money costs. It was explained in Chapter XVII that physical costs must be single-unit costs and cannot be combined-unit costs.

Money costs will be described in this chapter as having *two dimensions*, physical inputs and prices per unit of input. These commonly need to be considered separately, since they vary for altogether different reasons.

As to the different *kinds* of costs, we have already distinguished, in Chapter XVII, between fixed or overhead costs and variable or prime costs. A further distinction is needed between *cash* or *out-of-pocket* costs and non-cash or *imputed* costs. The latter are the costs for which no direct cash outlays are made, and for which, if money costs are to be derived, some value must be imputed.

The term *joint costs* is used to refer to the costs of products which inescapably arise from the same production process, like cotton and cottonseed, or milk and meat. In this book we shall also follow the practice of some economists and use the term *supplementary* to refer to costs when two or more products use the identical productive agent at different times during the year. Much of the use of man labor, horse labor, and machines on diversified farms is supplementary and therefore involves supplementary costs.

Finally, when we get to discussing the use of costs in connection with selling programs and prices, we shall need to distinguish between *necessary*, *historical*, and *fair-price* costs. The costs computed by farm cost accountants come under the second of these heads — they cover costs incurred in the past.

THE USES OF COST DATA

Three major uses of farm cost data must be kept separate: (1) in organizing and operating farm production; (2) in selling and price programs; and (3) as a measure of economic change. This chapter will deal very largely with the first.

The uses of cost data in farm production may be distinguished as follows:

A. In setting up farm budgets and pre-estimating the receipts and expenditures of alternative operating plans; and also in farm planning.

B. In determining the highest-profit input of any input factor and the output or yield which maximizes profit.

C. In determining which farm practices pay best.

D. In choosing which kinds or types of productive agents maximize profits — horses versus tractors, etc.

E. In determining what combination of lines of production maximizes profits.

F. In determining ways of reducing costs and maximizing profits at the same time.

Let us now consider these uses separately and in order:

A. IN FARM BUDGETING AND PLANNING The largest use now being made of cost data is in farm budgeting and farm planning. Professor Andrew Boss writes of this use of farm cost data as follows: Such data will serve a farmer "as a basis for making trial budgets of different combinations of his farm enterprises and forecasting probable results before settling upon his yearly production program. In this way it is possible

for him to fit his program to probable labor and power supplies and to estimate in advance and provide for needed feed and material requirements. Study of the results of past operations will reveal the weak and the strong enterprises that enter into his farm organization plans and contribute to the net income. Knowledge thus gained should result in a steady improvement in efficiency of production." [1]

The budget analyses made in earlier chapters reveal the nature and extent of the cost data needed for them. Thus, testing out the effect of shifting from the A to the B cropping systems on the two-man potato farm in Maine required the following cost and other data:

1. The yields of potatoes, oats, and clover under the two systems, and at differing rates of fertilizer use.
2. Amounts of potatoes and oats used for seed; also of clover and grass seed used; and prices paid for any of these purchased.
3. Similar data for materials used in sprays and seed treatment.
4. Quantities of gasoline, oil, and grease used.
5. The distribution of labor over the year on each of the crops, and the amounts of man labor and horse labor ordinarily used on the different operations.
6. Amounts of labor used in cutting seed and picking potatoes, and the piece rates paid.
7. Capacities of alternative types and sizes of equipment, and the work load for each type under the different cropping systems.
8. The quantities of oats and hay and purchased feed normally fed to 2 horses, 2 cows, 2 head of young stock, 30 hens and 3 pigs, and prices of purchased feed.
9. Relative yields with purchased certified seed, with seed grown in the farmer's own seed plots, and with ordinary field-grown seed.
10. Prices of all products sold.
11. Fixed costs — taxes, insurance.

If cost data are to serve such a purpose well, they must conform to the following specifications:

1. They must keep physical costs and money prices or cost-rates separate. Only if they are separate can they be adjusted to fit different cropping systems and farming practices, and to fit the changing prospective prices of potatoes, seed, fertilizer, sprays, and wages of labor from year to year. Farm budgets and plans always look to the future.
2. They need to be expressed per acre, per cow, and the like, more often than per unit of product.

[1] "Forty Years of Farm Cost Accounting Records," *Journal of Farm Economics*, February, 1945.

3. They must fit this particular farm well. They need not be data obtained from records kept on this particular farm, but if not, they must be for another farm which is organized like this one, or better, a small group of farms organized like it. Average man-labor and horse-labor inputs for groups of farms, some of which have tractors and some not, are of no use whatever in setting up farm budgets. No farm could afford to own a tractor and use it 2.0 hours per acre on potatoes which may be the average obtained when three farms with tractors are averaged with ten which have not. Of course, the average horse-labor hours in such a case are of no use either. Neither are averages of any use for farms some of which have hay loaders and some not; nor average commercial fertilizer inputs for farms using widely varying amounts of barnyard manure on their potato or tobacco crops; nor man- and horse-labor inputs on Texas High Plains cotton farms using variously two-row, three-row, and four-row cultivators; nor average concentrates and silage fed to milk cows in a group of herds consuming varying proportions of concentrates and silage as well as of alfalfa. (*The student will find that some of the bulletins cited at the end of this chapter contain tables of cost data that do not meet this specification.*)
4. Cost data for use in budget analysis need to be adjusted constantly for changes in technology. They may get much out-of-date in five years. If they are differentiated according to the type of equipment used and the like, however, only a few of them may need to be changed.
5. The cost data for major variable inputs, like fertilizer for potatoes and feed for livestock, should as far as possible be in the form of a range of inputs with an accompanying range of outputs. They need to show how the outputs vary with the inputs. Feed-input data should similarly indicate the effects of varying proportions of roughage and concentrate in the ration and of differing ages of fattening animals. The existing feeding standards largely but not wholly meet this need.

One finds in the literature on farm management a common use of the term *requirements*. This book makes use of it also, but discriminatingly. The word requirements carries the implication that the inputs are "constants" or definite amounts that must be provided. Much of the time, the simple term *inputs* conveys the meaning more precisely, or the phrase "amount used," or "average inputs." It should be apparent that average requirements by states and by regions in which widely differing cropping systems, feeding practices, and machines are included cannot be safely used in farm budgeting and planning until they are properly adjusted.

Further emphasis is needed on the point that cost data for planning and for most other purposes must be in physical and price terms separately. The fact that money costs have two dimensions is not of great importance in itself. The important thing is that a farm manager needs to know these dimensions separately if he is going to make good use of cost data. A statement in an experiment station bulletin that the feed cost of a cow is $80 a year is of little use to a dairyman in this form. He needs to know what makes it multiply out to $80 — how much of the $80 is due to prices and how much to quantities of the different feeds. The reason for this is that the quantities and the prices or cost-rates change from year to year, each according to its own pattern. Feed prices change almost as frequently as the prices of the grain which the farmers sell. Fertilizer prices fluctuate less, but they change enough so that the price factor in fertilizer cost must be constantly watched. Wages of farm labor have fluctuated over a range of over 100 per cent since the First World War. The physical dimensions of money costs change less from year to year than the cost-rate dimensions. Some physical inputs remain fairly constant for long periods. Others change with changes in technology, with the introduction of improved equipment, with better cultural methods, or with new varieties. The introduction of the tractor combine changed all of the physical input factors in the money costs of producing wheat.

The uses of cost data in production are always in planning either next year's production program or some longer-time program. Such planning must be on the basis of some set of prices. Of course, no farmer knows what the prices will be. But he is on safer ground using his best judgment as to what prices will be than in assuming that prices or wage rates over the next five years will be the same as in the past. Although the physical dimensions of cost change less rapidly, the farm manager needs to keep on the alert with respect to changes in them.

B. IN DETERMINING HIGHEST-PROFIT COMBINATION If a producer knows what the last input of any factor of production cost him, what additional product he is getting from it, and what it is selling for, then he knows all he needs to know in order to produce up to the point where he makes the most profit. As explained carefully in Chapter XVII, there may be some other variable inputs increasing at the same time, like picking and hauling costs as potato yields increase, or milking costs as more feed is fed. These variable costs added together make up the combined costs that are to be matched against the selling price. They can be reduced to a unit-of-product basis, or kept on a per-acre

basis, or figured per 100 pounds of feed, or of fertilizer — the differences are mere matters of arithmetic.

Any data that can be supplied a farmer as to yield increases with additional inputs of fertilizer on farms or soil types like his, or as to milk production, or gains in weight of hogs or beef cattle with additional feed, will be of much help to him in pre-estimating the probable output of milk or gains in weight on his farm. The fertilizer input-output data may not fit his farm closely, but he will discover how to adjust them after a few trials. The dairyman especially can pretty well figure out his own increases in output if he keeps a few records. Measuring gains in weight as they take place is too much of a task for most farmers, but something can be learned from comparisons of the selling weights or gains in different years.

The difference between cost data in this form and in the form of averages needs to be strongly accented. Most of the cost data now being supplied farmers are averages derived from performance on a group of farms where inputs have varied widely. Even if they were all from one farm, they would still be averages. The 380 bushels of potatoes obtained on Aroostook farm where 2,000 pounds of fertilizer were applied was really a combination of the results from four different rates of application of fertilizer. The 500 pounds applied on the first plot brought forth 225 bushels. These bushels cost only 2.2 pounds of fertilizer per bushel. When 1,000 pounds were applied, the average cost per bushel was 3.4 pounds. This average of 3.4 pounds was a combination of the 225 bushels on the first plot and the 75 additional bushels on the second plot produced by adding the second 500 pounds of fertilizer. The 5.3 average when 2,000 pounds of fertilizer were used was therefore a combination of the results with four different 500-pound inputs. Thus any *average*-cost figure is a combination of the costs accompanying different increments of input. What the potato grower needs to know instead of this is that when 500 pounds were added to the first 500, the additional 75 bushels cost 6.7 pounds of fertilizer per bushel. Similarly, the 50 additional bushels with the third 500 cost 10 pounds of fertilizer per bushel, and the 30 additional bushels with the fourth 500 cost 17 pounds of fertilizer. The amounts he pays for these 10 and 17 pounds of fertilizer, he can match against the price he expects to get for his potatoes, making additional allowances for any other additional costs that may be involved.

The usual procedure for dealing with this problem by means of averages is to get the yields, or outputs per cow, or gains in weight, for a group of farms and also their costs per bushel or hundredweight, and

to put the results into a table like Table 57. Such a table tells us that the farms with high money costs per barrel have lower yields than those with low money costs, but does not tell us *why* some have low yields and high costs at the same time and some the opposite. Such a table also carries the implication that any farmer can lower his costs by increasing his yields up to somewhere beyond 149 barrels per acre. Such data may also be put on a chart like Charts 71 and 72 in Chapter XXII, and in this form they are more revealing, but still not highly useful as a means of finding the highest-profit combination for any one farmer, as is explained in Chapter XXII.

TABLE 57. RELATION OF YIELDS TO COSTS ON FARMS IN THE ST. JOHN RIVER AREA OF AROOSTOOK COUNTY, MAINE, 1937

Yield per acre of potatoes	*Farms*	*Average yield per acre of potatoes*	*Potato production cost*	
			Per acre	*Per barrel*
Barrels	*Number*	*Barrels*	*Dollars*	*Cents*
Less than 85	36	70	103	146
85–109	85	98	105	107
110–134	73	121	113	93
135 or more	47	149	128	86

Source: W. E. Schrumpf, *Farm Organization and Costs and Returns in Producing Potatoes on Farms in the St. John River Area of Aroostook County, Maine, 1937,* Maine Bull. 406, 1941, p. 64.

On diversified farms, it is not sufficient to determine the highest-profit combination for any one product by itself. With two or more crops produced on the same farm, a choice frequently has to be made as to whether to apply the last inputs of available labor to one crop or to the other at a particular time. This problem always arises when the crops are in any way competitive in their use of any factor of production. The decision should always be in favor of the application which will add the most to the income of the farm as a whole, not to the receipts of any one crop. The farmer cannot afford to put time on another cultivation of his cotton crop when he will sacrifice more farm income by not applying the same labor to his peanut crop, or in many cases to his corn crop. Both cotton and tobacco growers are very likely to make this kind of mistake. They are so concerned over getting a good money income from their cash crops that they neglect the crops which provide the feed for their workstock and thus spend more money on feed bills than they gain in extra cash income from their cotton or tobacco.

The only procedure which will really insure that the marginal inputs and outputs of different lines of production on a diversified farm are kept in good balance is to set up the data in budget form so that all expense and receipt items can be adjusted for any change in the input of any factor. This is highly important with two or three crops grown in rotation because the inputs of one crop are related to the inputs of the others. The amount of nitrogen applied to a crop does not affect the other crops much since it is largely used up in the year applied, but phosphate and potash carry over to succeeding crops. If applied to legumes, these contribute additional nitrogen for succeeding crops. Only a budget type of presentation will bring together all these different effects on receipts and expenses of the farm business as a whole.

C. IN DETERMINING BEST FARM PRACTICES When inputs do not form continuous series such as those for feed and fertilizers, but take the form of whether or not to treat seed, or whether or not to harrow after corn planting, or whether to cultivate three, four, or five times, it is customary in farm management literature to refer to them as *farm practices*. The more usual method of relating these to costs is to estimate the money costs of these practices, and perhaps also figure the average yields of those farms which follow each of the practices. Thus, Maine Bulletin 390 compares the costs per acre of spraying versus dusting potatoes;[2] and Michigan Bulletin 267 compares the costs of planting potatoes before and after June 5th, and different rates of seed application, spraying, and even amounts of man labor used per acre.[3]

The most elaborate analysis of farm practices yet made is that of the Illinois Agricultural Experiment Station of a long list of practices in the growing of corn and oats, and in beef, dairy, and hog production.[4] The analysis of cropping practices limits itself to determining the average yields with different practices, but the livestock results are in returns per $100 of feed. Approximately 1,000 farms and 3,000 fields were covered in the crop-practice analysis, and 800 farms in the livestock analysis. The results are simple statistical averages. The effects of cropping practices on corn yields are shown separately for farms with "good," "fair," and "poor," treatment of the soil. "Good" treatment meant any two

[2] W. E. Schrumpf, *Costs and Returns in Producing Potatoes in Aroostook County, Maine*. Maine Bull. 390, 1937.

[3] P. F. Aylesworth, *An Economic Study of the Potato Enterprise in Michigan*. Michigan Bull. 267, 1935. Data on the effect of amounts of labor used, and number of cultivations and the like really belong under B. They are included under "practices" in most discussions.

[4] M. L. Mosher and H. C. M. Case, *Farm Practices and Their Effects on Farm Earnings*. Illinois Bull. 444, 1938.

of the following three practices: including clover in the rotation, applying barnyard manure sometime in the preceding four years, or having applied rock phosphate sometime in the past. "Poor" treatment included none of these. Yields averaged 44.6 bushels with poor treatment and 53.2 with good treatment. (The differences would be much greater if the soils were not so fertile inherently.) Timely working of the soil in the spring added 1.7 bushels per acre with all three soil treatments; harrowing after planting, 1.6 bushels; and planting before May 10th, 1.4 bushels. Using shovel cultivators added 1.8 bushels with poor soil treatment, and the lighter tilth with blade cultivators a bushel more with good soil treatment. Averaging about three stalks in the hill rather than about two gave 4.3 bushels more per acre with good soil treatment, and 2.7 more with poor soil treatment. Three cultivations gave as good yields as four or five with good soil treatment.

Results in this form lend themselves to a balancing of costs with returns, since prevailing prices can be applied to the physical inputs and outputs. The farmer can also figure the cash costs separately from the non-cash. He can also decide between taking time to do some other work and hurrying to get the rest of his corn planted before May 10th; also whether it is worth while to have enough help and equipment to do both of these at the same time.

The limitations of such data are that most of the differences analyzed are positively correlated with other factors, principally with good, fair, and poor all-round management and with the quality of the land, so that the differences in results reflect more than the differences in practices. Good management consists of good practices, plus fully as much more that cannot be reduced to terms of separate practices. This something more is likely to be found on the same farm as the good practices. Probably the classification of farms according to soil treatment provided a rough rating according to quality of management. The Michigan Bulletin just cited attempts to meet this difficulty by giving each farm a rating according to "percentage of good practices" followed. Those with ratings of 75 and above had an average cost in 1930–1934 of 31 cents per bushel of potatoes, and those with ratings under 25, an average cost of 39 cents. Part of the difference between the 31 and 39 reflects the good management that accompanied the good practices. The significance of these correlations with quality of management and land is that *any one farmer cannot expect to get the average increases in yields presented in the Illinois and Michigan bulletins*, but usually something less if he is a good manager, because he is already getting part of these results, and also something less, for other reasons, if he is a poor manager.

Quality of land, or of cows or other livestock, may likewise be correlated with good practices. The dairy farms with good cows are pretty sure to be the ones with the best feeding and other practices. An apparent correlation of amounts of labor on cows with production per cow may arise wholly from difference in the quality of the cows.

Besides these limitations of such data, there is also always the serious danger that the money rates applied in determining the costs of specific practices will be too high or too low. This will commonly be true of man-labor rates if figured, for example, by dividing the total wages paid by the total hours worked and applying this to the labor done on all operations. This makes the practices which come at slack seasons of the year appear to cost too much, and the reverse if they come at peak-load periods. Methods could be developed for adjusting labor cost-rates for the different operations and crops. They might, for example, give 20 cents an hour for planting oats and 35 cents an hour for harvesting it. The comparable figures for corn might be 45 cents for planting, 30 cents for cultivating, and 40 cents for harvesting. But determining such rates would require involved record-keeping and analysis, which only very large farmers are in a position to undertake, and which experiment stations in only a few instances have undertaken. And they are not likely to undertake them because the questions which need to be answered in actual farm management situations can be answered more easily and more usably by considering the farm business as a whole and estimating the effect of different practices on receipts and expenses in a farm budget.

D. IN CHOOSING WHICH KINDS OR TYPES OF PRODUCTION AGENTS This problem was considered in Chapter XVIII from the standpoint of the combination of productive agents. It is also approached frequently from the cost side, to discover which types of machines or other equipment have the lowest cost per acre or per bushel. If effects on output are considered at the same time, these approaches are identical. Often in practice, only cost differences are analyzed. It is highly important that physical costs and prices be recorded separately in such comparisons, so that adjustments can be made with changing prices of the input factors, of costs of the equipment, of prices of the product, and of changing efficiency of the machines; and that the cost-rates applied allow for differences in the demand for labor and equipment at different periods. Any conclusions reached need to be tested by seeing if they are in accord with those obtained by budgetary analysis. The type-case of this kind of analysis is that of horse versus tractor power.

E. IN DETERMINING THE COMBINATION OF LINES OF PRODUCTION The procedure outlined in this book for determining the combination of crops, or of crops and livestock, which will pay best on any farm, is that of budgeting different promising alternatives to see which promises to return the most to the farm business as a whole. The cost data needed for this have been outlined under A above.

In times past, a procedure frequently used has been to estimate the unit costs of the different crops and livestock products, and compare these with the selling prices, to see which one had the widest margin of profit, or in some years, the least loss. Professor Boss speaks of this objective of the early farm cost accounting work in the following terms: "Rather the objective was to secure basic data first-hand that could be used in determining which crops under certain conditions gave the greatest net profits when grown for market and which crops could best be worked into farm crop rotations that, over a period of years, would yield the best returns to the farmer." [5]

Unit costs for such comparisons obviously need to be expressed in physical and price terms separately; otherwise, it will not be possible to recompute the unit costs a few years later when the wages, feed prices, and efficiency of machines have changed.

One limitation of this procedure is that it does not indicate the direction to go in recombining enterprises. It is not at all safe to assume that the ones with the lowest profit should be contracted, and the ones with the highest should be expanded. One enterprise may have high costs partly because it is too small, or one with a relatively wide margin might have a wider one if it were not so large. Furthermore, it is extremely difficult with such methods to take account of the supplementary and complementary values in enterprise combinations. There would be nothing gained by contracting a farm enterprise that does not conflict with those with apparently wider margins. If it conflicted in part, still the fact that a good share of its costs are supplementary would need to be taken into account. On the other hand, a crop that is already overtaxing the labor and equipment of the farm, and can expand only by adding labor and equipment, should be charged not only for these additions if made, but probably for some of the expenses already incurred that would not be incurred if this crop were not expanded so much. Results obtained by comparing unit costs with prices therefore always need to be checked against effects on the receipts and expenses of the farm business as a whole.

[5] Andrew Boss, *op. cit.*

The difficulties with this method of determining the best combination of such enterprises are familiarly illustrated by the oats and dairy enterprises on Midwest farms. If oats is the only enterprise that can employ the working force and equipment on such a farm in April, any net returns to these from the enterprise may be an addition to the net income of the farm. The oats also serve as a standard feed for horses, and as a nurse crop for clover, and the clover increases the corn yields. In the full analysis, all of these values must be included. Practical farmers kept on growing oats in the northern Corn Belt after their horses had been replaced by tractors, until soybeans were introduced; and they still grow large acreages of oats, although it can easily be made to appear a losing crop in unit-cost determinations.

The dairy enterprise also often appears to have relatively low margins of profit or even losses, but it uses labor in the winter when it is otherwise unemployed, also before and after the field work each day, and the unpaid labor of the family as well. It is therefore not safe to conclude from a showing of costs and margins that either the oats or the dairy enterprise should be contracted or expanded. The same difficulty would arise in combinations of beef cattle and hogs with corn in the Central Corn Belt, or wheat and corn in the southern Corn Belt, or wheat and beef cattle in the Great Plains, or cotton, tobacco, peanuts, and livestock in southern Georgia. The difficulties of including long-run effects on the soil in costs are the same as those of including them in budget analyses. Such effects must be roughly estimated at the best. This is more likely to be done in budget than in cost analysis, because unit costs are commonly assumed to be precise.

F. IN REDUCING COSTS OF PRODUCTION Farmers are commonly told that they have three ways in which to increase their income. One is to produce more. We have already observed that this may not help if all producers do the same thing. The second is to secure a higher price for their products. What an individual farmer can accomplish along this line is definitely limited. The third is to lower their costs. This, it is often said, is something that any farmer can do for himself, and the benefits are all his. This last statement goes too far. New ways of reducing costs presently spread to other producers and usually cause output to expand, thus lowering prices. As cost-saving methods spread, the benefits are shared by society generally. The people of this and other countries are living better because tractors and combines have lowered the price of wheat. The people of this country and others are already clothed better because of the cheapening of cotton production.

But this spreading of cost-saving methods takes time, and in the meantime those who first use them enjoy larger incomes. Some of the methods in fact, take so long to spread that the backward farmers are always far in the rear as a result. Wide differences among farmers in costs are commonly found even when the records of a series of years are averaged to remove the effect of fluctuations in yields and the like. The farmers who lag in adopting improved methods are sure to have high costs and low incomes. Reducing these costs is therefore one of the major farm management problems.

First, however, it needs to be restated that not under all circumstances is lowering of costs desirable. Earlier analysis has made it clear that both marginal and average costs may rise and profits may increase at the same time. They were doing this between the points of least-cost and highest-profit combination in the feeding of cattle and application of fertilizers in Tables 45 and 48 in Chapter XVII. In fact, if farmers are to reduce unit costs without lowering revenues, they must do so before the Point LC.[6] Beyond HP, however, revenues decline as unit costs rise. No large volume of production takes place beyond HP. Breeders of dairy cattle trying to make peak production records commonly feed beyond this point. The usual reason for it with livestock is that so much feed is fed that some of it is wasted. This can happen very easily under full-feeding programs. Using fertilizers beyond HP happens on vegetable farms in years when markets are glutted and prices low. Most truck growers use fertilizer regularly almost to the point of highest total output, fertilizer costs being such a small fraction of the value of their crops.

No doubt, however, a much larger number of farmers are using some of the productive agents between LC and HP and would gain from increasing the inputs of them per unit of output rather than decreasing them.

Apparently the largest group of all, however, are producing before Point LC for some of their more important cost factors. In fact, a superficial interpretation of the usual tables or charts, like Table 55 above, and Charts 70 and 71 in Chapter XXII, showing the relation of yields or outputs to costs, would suggest that all of them are producing below Point LC, for these tables seem to show costs still declining for the group with the highest yields. Such a conclusion would be in keeping with the general opinion of agronomists and dairy and animal husbandmen that most farmers are satisfied with too low yields and production;

[6] These statements assume no change in technology. A lowering of costs that comes from improved methods will increase revenues at whatever point it occurs, at least temporarily.

that they do not use enough fertilizer, or care for their crops well enough, or use enough feed.

But it is by no means necessary to accept these conclusions. Part of what appears in these tables is due to the fact that the least-cost points for different potato and dairy farms vary over a wide range. Point LC may be as low as 4,000 pounds with some dual-purpose or low-capacity dairy herds, and can be beyond 10,000 pounds for very high-producing cows. There may be an equally wide range in the ability of soils to convert fertilizer and other input elements into potatoes. Under these circumstances, tables *such as the foregoing would appear even if each farmer were producing at his LC point. The tables in this case would merely show the range in the LC points of the different farms.* The tables really reflect two things, the range in LC points, and the production of individual farmers on both sides of their LC points, with probably more of it to the left than to the right of them. The rising costs of those to the right are outweighed in the averages by the declining costs of those to the left.

It is important to remember in this connection that many things enter into costs. Farmers may be using as much fertilizer or feeding as heavily as is profitable, yet failing to follow through with the necessary care required to obtain high outputs. It takes many practices timed just right throughout the year to obtain high yields per acre or per cow. Failure at any critical time to perform the practice when needed and in a good workmanlike manner may reduce yields substantially with very little reduction in costs. The task of reducing costs is much more than adjusting the rate of feeding or use of fertilizer. Furthermore, tables or charts showing the relation of yields or outputs to unit costs have little value in themselves. They cannot be used as a guide for action. If yields are to be increased to the advantage of any farmer, this must be determined on the basis of an analysis of all the circumstances affecting yields and costs on his particular farm.

Such analyses, to be really helpful, must be in other terms than combined or unit costs. Unit costs need to be broken down in several ways and examined in detail. One breakdown is according to the *input factors* — land, man labor, horse labor, equipment, seed, etc. Another is according to *processes or operations*, such as plowing, spraying, digging, etc. The breakdown by input factors may be illustrated briefly by the following:

1. *Feed costs* Not only is the quantity of input involved, but also the balance between protein and nonprotein feeds and between roughages and concentrates. The proportions of these vary with the rate of feeding; and also with the nature of the output desired — whether it

is more milk, or more butterfat, or more flesh and fat, or more growth in young animals. The poultryman has his special rations for growing chickens, laying hens, etc. Once the most economical balance is determined, the further problem arises of the cheapest source from which to obtain the desired feed elements. This calls for knowledge of feeding values and for watching markets closely — in fact, for such a high degree of detail that many farmers make no attempt at working out good rations and feed mixtures, but rely upon assistance which they may obtain from a co-operative supply service, or on the local feed stores, or on advice from the Agricultural Extension Service.

2. *Hired labor* The first problem in hired-labor costs is to hire a good man for the wage. The second is to work out the best combination of regular, seasonal, and casual or piece-rate labor. The farm needs labor enough to handle the work on time, but a balance needs to be determined between the extra costs of timeliness of the work and the cost of the extra labor. If a frost is threatening a tobacco crop in Wisconsin, an extremely high expenditure on labor may be warranted for a few days; or if a potato crop is suffering badly from blight because of several days of rain. Given a regular labor force, the problem becomes one of using it from week to week and day to day at the tasks most important to be done at that time. On larger farms such as the Los Angeles dairy farms, the division of labor within the labor force may be important.

3. *Horse work* Horse-labor costs vary greatly according to how much horse work is available — the overhead on horse labor includes a maintenance ration as well as the usual fixed costs. If too few horses are used, important operations may be delayed seriously. Even if three horses are able to do all the work on a farm in 330 days of the year, what a fourth horse can contribute by making it possible to put two two-horse teams in the field in the remaining 35 days may be worth much more than the costs.

4. *Tractor costs* First is the problem of getting a good tractor for the money — one that gives good service, stands up under use, and is economical of fuel. Second is that of selecting the right size and type of machine for the particular use required. If the machine is too large, it will use too much fuel hauling itself around. If it is too light, it will not do the work required without much waste of time. Once the tractor is selected, the problem arises of how much to use it. The tendency is for farmers to use tractors too much for odd jobs that could be done more economically by horses. Decisions need to be made such as

Milking Such questions are involved as type of unit for machine milking and equipment for handling the milk coming from the machines. Recent developments in fast milking techniques, involving the application of hot towels to the cow's udders, have greatly reduced the milking time and probably obviated the need for most stripping.

Barn chores Good planning and layout of the barn, and proper equipment for handling the feed and cleaning the barns, may reduce the labor time, and the number of miles walked each day, by as much as a third on many farms. The general approach to controlling such costs is in part that which has been developed by the methods of so-called scientific management, discussed in later chapters. Choices sometimes need to be made between additional expenditures on laborsaving equipment and the contribution to the farm income that will result from the introduction of such equipment.

The reports of farm-cost studies commonly include the average costs both by input factors and by operations for the group of farms studied. But cropping systems and practices vary so much within the group that the average may not fit any farm. Part of the farms may have tractors and part not; some may spray, and some dust; some may use a two-row digger and some a one-row digger. Some may hire a year-round worker and some a crop-season worker only. If averages of this kind were figured separately for farms following one set of practices, they could serve as rough guides to individual farmers. The farmers following any set of practices would at least know which of their factor and operation costs were higher or lower than the average. Averages thus calculated are sometimes called "standards," meaning standards of good performance; or "efficiency factors." As such, they will be discussed with some care in Chapter XXII. Suffice it at this stage to point out that for this purpose they are much more useful if given by input factors and by operations than in their combined form.

Any farmer who keeps records can figure out a number of such ratios — feed per hundredweight of milk or gain in weight, or hours of labor, or acres of crops or pasture. These are useful in comparisons of performance from one year to another, or with average ratios that may have been compiled for these areas. A large farm specializing in one product will find it helpful and highly useful to have a unit cost for its product that it can observe from year to year. Computing it will require only dividing its total expense on the balance sheet by its output. If it turns out several products, however, the method which it uses in allocating costs between products may affect the relative showing in different years.

Finally, it cannot be too much emphasized that the control of any cost involves a price or cost-rate dimension and a volume-of-input dimension. Control of the cost dimension means, under all circumstances, buying as cheaply as possible. By buying cheaply is *not* meant paying the lowest price for materials or equipment, or hiring the lowest-wage labor. Rather, it means getting the most for one's money.

COSTS AS A GUIDE TO SELLING PROGRAMS

Although some farm cost accountants in the United States still occasionally supply milk producer associations and other producer groups with estimates of unit costs of producing milk to be used in determining what the price of milk should be, a majority of them now, like Professor Boss, in the article cited, disclaim such a use of unit-cost data. But some of the producer groups in this country still think that unit costs of production should be calculated for their products and that prices should be based on them. Some such program was being followed for a few products in Switzerland before the war, and the producer groups in some Latin-American countries are urging such programs on their governments. Great Britain adopted such a program at the end of the last war, but dropped it speedily when markets broke in 1920–1921. If farm prices are to be based on unit costs, how shall the term *costs* be defined for this purpose? As stated at the beginning of the chapter, three kinds of costs are possible, which can be defined in the following:

Necessary cost is the cost that must be met to call forth the supply which the buyers will take at that price. It really is the *equilibrium price* of a freely competing market defined in Chapter XX. In such a market, necessary cost can be determined by a statistical examination of quantities produced and consumed at different prices in the recent past, with proper projection into the future. There is no occasion for any elaborate detailed compilation of costs by factors of production. But if it is insisted that the cost be determined from the factors of production, the cost-rates assigned to land and proprietor and family labor must be low enough so that when the charges for these are combined with the out-of-pocket costs that must be met, *the total cost resulting is no higher than the equilibrium price*, that is, the price at which the producers will supply all the market will take. If cost-rates for land and labor are set higher than this, the prices thus determined will call forth a surplus. It may need to be pointed out here that the prices which Professor T. W. Schultz is proposing for his forward-price program are necessary-cost prices.

Historical cost This is the sum of the values of the actual inputs used in production, ordinarily in the recent past, commonly in the year just completed. It is this type of cost of production which is commonly figured by the farm cost accountants. Many difficult questions are involved, it should now be clear, in assigning proper charges to the use of land, labor, and equipment, and in allocation of costs among the different products in a diversified-farming system. It should also be apparent that a cost figure thus determined soon gets out-of-date. Also if based on a single year with yields or other circumstances more or less abnormal, it may not fit the years just ahead. Historical costs, if they are to have anything more than a pure historical value, therefore need to be based on average yields and other conditions, and also to be revised constantly to fit changes in production methods and in prices and cost-rates.

"Fair-price" cost This is a cost equal to the price which producers need in order to be able to support a standard of living which the farmers should have, either according to their own ideas on the subject or those of someone else who thinks he knows what the farmers' standard of living should be. Such a cost is figured by allowing the farm family a sufficient net income, or the farm operator sufficient wages of management, to enable the family to live at this level, and adding to it proper allowances for hired labor, upkeep of the land, use of equipment, and all the other things entering into costs of production. The resulting figures will depend very largely upon how high a level of living is set as a standard.

The difference between these three concepts of costs may be illustrated by taking the case of wheat. It is entirely possible that at some time after the end of the war, the wheat producers of Canada, the United States, Australia, and Argentina would produce all the wheat, if no production and export quotas were imposed anywhere, that consumers would take, at a price of 75 cents a bushel at 1940 price levels. This would be the *necessary* price of wheat. However, it is not likely that the wheat producers of some countries would be content with such a price. They would say that at this price for wheat they could not live at levels comparable with those of city workers in their countries, and even with those of some other agricultural producers. In many countries the producers want at least $1.50 a bushel for wheat. This is their notion of a *fair* price.

The historical-cost figure that the usual farm accountant would obtain would come somewhere between the *necessary* price of 75 cents,

and the *fair* price of at least $1.50. The usual farm cost accountant chooses cost-rates on land, proprietor and family labor, animal labor and equipment, such that when combined with out-of-pocket costs for seed, feed, fertilizers, hired labor, threshing expense, and the like, he gets a figure which is some sort of a mixture of necessary and historical cost.

In the United States, the question of which of these three costs to use has been side-stepped since 1933 by setting up a "parity" standard for farm prices. There were many in the United States who would have preferred to use "cost of production." In fact, the Senate very nearly substituted cost of production for parity price when the original A A A Act was passed in 1933; and in June of 1945, the Senate again passed an amendment to the O P A price control that would have made "cost of production" the standard. (The House again refused to concur.) This proposal was opposed by Secretary Wallace in 1933, and by those who were to be given the responsibility for administering the act, on the ground that in actual practice so-called cost of production furnishes no dependable standard because the price which is wanted by producers is a fair-price cost and not a necessary-cost price, and that fair-price costs mainly depend upon what farm income is set up as desirable.

It should be clear from the foregoing that whenever some standard such as parity or cost of production is set up, and the price thus determined is above the necessary or equilibrium price level, some additional machinery is necessary to make such a price stand up. This machinery can take the form of production control, export subsidies, or diverting surpluses to lower-order uses like feeding wheat to livestock, or disposal of surpluses among low-income families and the like.

If a public agency is instructed by its legislature to fix prices at cost of production, it must decide which of the three kinds of costs named it will use as a basis, necessary cost, or fair-price cost, or some mixture of the two that may be called historical cost.

COSTS AS A MEASURE OF ECONOMIC CHANGE

In tracing the course of economic change in a region or area, costs must be included as well as prices. Unit-cost series that are continued in the same area for five years or longer serve such a purpose. Such use is well illustrated by the Illinois series which run back to 1913.[7] If one wants a clear understanding of changing costs, and how they fit into

[7] R. H. Wilcox and H. C. M. Case, *Twenty-five Years of Illinois Crop Costs*, 1913–1935. Illinois Bull. 467, 1940.

the total picture, however, one needs series such as presented in Chart 70. These show the cost picture for the two-man Aroostook potato farm described in Chapter VII. It will be noted in the upper section of the chart that the actual physical quantities of the input factors increased a great deal over this period. This was because of a two-thirds increase in production over the period, combined with an increasing use of fertilizers, sprays, and power machinery. The prices of these input factors declined greatly in the same period, because of a general decline in the price level but also for other reasons. Farm expenses, which are the multiplication product of these two series, rose until 1929, and fell off in the Big Depression, and rose only with volume of inputs in 1935–1938.

When these series are reduced to a unit basis, either per bushel or per barrel, as in the lower section of the chart, the costs appear to have decreased. Increasing yields are mainly the reason for this. Quantities of inputs per bushel fluctuated considerably from 1923 to 1935, but the level remained the same. Low yields caused the rise in 1938.

COMBINED UNIT COSTS Of the eight uses of cost data discussed in this chapter, practically none of them absolutely requires combined or unit costs unless legislation requires prices to be fixed on this basis. Unit costs are sometimes used in determining what combination of lines of production pay best, but they are not at all necessary. They are sometimes set up as guides towards reduction of costs, but their usefulness for this purpose is not large. Index numbers of changing costs and related data serve most of the needs of a measure of economic change. Nevertheless, costs are still being computed in money-unit terms. Space does not allow examination of all the difficult problems of imputation and allocation of costs that are involved in such undertakings. They are least on a one-crop farm where all the labor is hired, and most on general farms using much family labor. But even on one-crop farms, there is wide room for argument as to the rate of charge for the use of land and buildings. On farms using family labor, the method of imputation followed commonly causes enterprises using much family labor to appear to be carried on at a loss. On diversified-crop farms, the man- and horse-labor charges and machine cost-rates need to be adjusted to fit the system of supplementary relations that prevails, and likewise for the land charges. The adjustments in cost-rates are still more involved on crop-and-livestock farms, as indicated above. The uniform rates now charged in most farm accounting often cause the enterprises to appear less profitable which are the most essential to the success of the farm.

Finally, it must be recognized that not many farmers can afford the time for cost-accounting procedures that involve keeping a full record of the use of all labor, equipment, feed, and other supplies, and then converting these to unit costs. Yet unless this is done, they have little use for the unit-cost figures compiled by some experiment stations. To know that the average cost of producing a bushel of corn was 57 cents in one's state in 1935–1939 does not help a corn farmer much unless

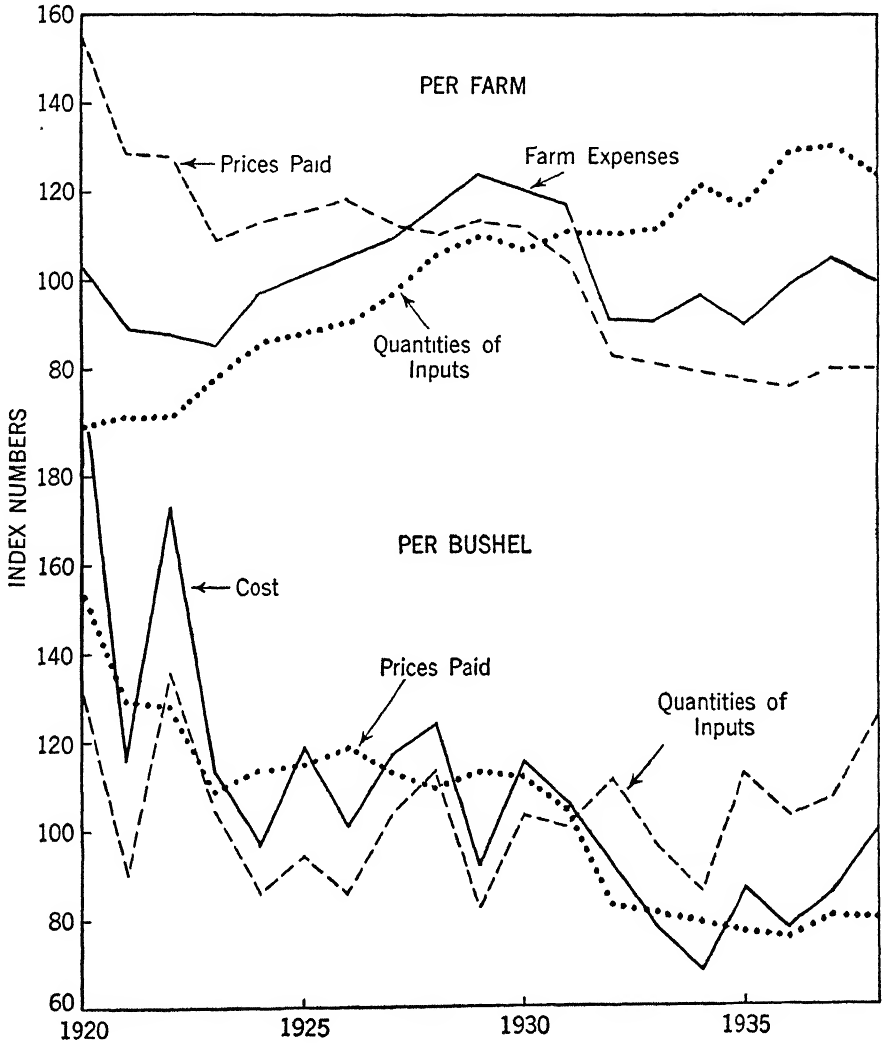

CHART 70. Index number of costs per farm and per bushel of potatoes broken down into their quantity and price components, for a typical two-man Aroostook potato farm, 1920–1938.

he has figured his own unit cost. Obviously, then, for practical use by farmers, relatively simple records, and still simpler methods of analysis, are needed. (The nature of these has been clearly indicated in this chapter, and Chapter XXIII will discuss this phase of the problem further.)

FURTHER READING

The following are included as a sample of recent publications presenting the results of farm cost-accounting analysis in the United States:

William E. Schrumpf, *Costs and Practices in Producing Potatoes in Southern Aroostook County, Maine, 1941*, Maine Bull. 432, 1944.

R. H. Howard, *Eighth Annual Summary Florida Citrus Costs and Returns*, Florida Misc. Pub. 28, 1939.

*John W. Carncross, Allen G. Waller, and Emil Rauchenstein, *Power and Machinery Effects on Management and on Costs of Potato Farming in New Jersey*, New Jersey Bull. 649, 1938.

* Gerald A. Lee and Arthur J Cagle, *Cost of Producing Milk on 183 Washington Farms in 1942–43*, Washington Extension Bull. 308, 1943.

H. E. Selby, B. W. Rodenwold, and H. D. Scudder, *Cost of Horse Labor on Oregon Farms*, Oregon Bull. 250, 1929.

* G. E. Smith, *The Value of Farm Manure*, Missouri Circular 248, 1943

*H. F. DeGraff and L. E. Slater, *Costs and Returns from Farm Enterprises, Cost Account Farms, 1940 and 1942*, New York AE 484.

*R. P. Matteson and H. W. Hawthorne, *Cost of Production of Potatoes*. U.S.D.A., Bureau of Agricultural Economics, Washington, D. C., 1937.

Handbook for the Use of the Delegates, Third Inter-American Conference on Agriculture, Vol. IV, 1945, *Farm Cost Analysis*, Pan American Union, Washington, D. C.

S. A. Eugene and G. A. Pond, *A Preliminary Report of Data Secured in 1941, 1942, and 1943 on the Farm Accounting Route in Nicollet County, Minnesota*, Mimeographed Report 146, University of Minnesota, 1944.

EXERCISES

1. If you were going to replan your home farm, or any other farm with which you are familiar, what cost data would you need? Briefly describe the present organization of this farm, and list the items of information you would need in replanning it.
2. How much of the above information could you get from published sources? Opposite the item of information listed above, give the best source of information. On the whole, how well does this information fit this particular farm?
3. Get experimental data from your soils department and compute the additional cost of the increased yields of a crop obtained when different amounts of fertilizer have been applied.
4. What are the major steps farmers in your community can take to reduce production costs in the next few years? How will these steps affect the supply of products flowing to market?

CHAPTER XXII

Measures of Success and Factors in Success in Farming

FROM ALMOST THE BEGINNING OF THE STUDY OF FARM MANAGEMENT in this country, much effort has been given to measuring the success of farming businesses, or of farm-family undertakings or enterprises, and then of correlating various factors with these, such as size of business, yields per acre or per animal, or work-efficiency measured perhaps as crop acres per man or per horse or per tractor, with a view to discovering some general farm management principles or rules for a farmer or farm family to follow in becoming more successful. This chapter undertakes to describe and analyze these measures and the correlations with them.

MEASURES OF SUCCESS

Obviously no such assortment of measures of success as follows would be possible if precisely one thing were measured. Some of these measure farm business success more nearly, and some of them the success of the farm-family enterprise. Some are measures of income and others of something less than income.[1] Following is a description of measures now generally in use.[2]

A. GROSS FARM INCOME This is the cash income received from the sale of farm products, plus or minus changes in inventories. In some cases, the value of farm products used in the home is also included. This figure is often divided by the number of workers employed on the farm to determine the gross farm income per man, which may be computed for individual farms to show the differences in the "volume of business" handled per man.

[1] Using the term *income* for some of them, especially "labor income," has led to considerable confusion.

[2] The student should acquaint himself thoroughly with these by computing them for several farms.

B. NET CASH FARM INCOME This is the difference between the money income and the money outgo of the farm business. It is the amount of cash income left over from the farm business available for family living, investment, or savings.[3]

C. NET FARM INCOME (also called *Net Business Gain* in this book). This is net cash income adjusted for inventory increases and dĕcreases and depreciation. It is comparable to the net ncome figure accountants compute on corporate income statements. It is the net gain to the farm and farmer and his family from the farm business. It therefore includes the return on the investment. It indicates how much further ahead or behind the farm *as a business* is at the end of the year than at the beginning. It is *the difference between the beginning Net Worth and ending Net Worth as these are reckoned in ordinary bookkeeping. It is therefore the measure used in all the operating statements and budgets in this book.* In some states, the farm products used by the farm family are included in the receipts, but ordinarily not. (See F below.) One of the main reasons for leaving these out is the difficulty of imputing accurate money values to them. The value of the home-used products tends to be relatively constant from farm to farm and from year to year.

D. LABOR INCOME This is more precisely called the *labor and management income of the farm operator*. It is like *net farm income* or *net business gain* except for two deductions. The first is an estimated charge for the use of the capital invested in the farm business. This was intended by T. F. Hunt,[4] who first used this measure, to introduce a correction for differences in the size of farms, in order to put them all on equal terms so far as size is concerned. The second deduction is an imputed value for the labor of members of the family (not including the proprietor). This was introduced to put all the farms on an equal footing so far as amount of unpaid labor is concerned. What is left is therefore the return to the farm operator for his labor plus his management. In this measure also, the value of home-consumed farm products is not ordinarily included in the receipts, for apparently about the same reasons as given above. When labor income is carefully computed, the value of the dwelling is subtracted from the value of the farm in calculating the interest on the investment in the farm business, and the cash costs of boarding the hired help are also added to the wages paid hired labor.

[3] It is called *cash balance* in the Illinois farm account books. See Table 6, Illinois Bull. 491, P. E. Johnston and H. C. M. Case, *Twelve Years of Farm Accounts in Illinois*, 1945.

[4] At Ohio State University until 1903, then at Cornell University until he became Dean of the California College of Agriculture.

Two problems of imputation are involved in calculating this measure. One is the interest charge on the farm investment. The most direct method of estimating this is to get the farmer's estimate as to what his farm would rent for if rented for cash, and add to this an interest charge on his investment in working capital. Commonly, instead, the farmer is asked what his farm would sell for and some nominal interest rate, usually 5 per cent, is applied to this for all farms alike in an area.[5] If the first method is used, a deduction should be made for the taxes, insurance, and upkeep expenses, and for depreciation of buildings and fences, for the landlord has to meet these out of his cash rent. They are, of course, deducted in computing net farm income if the second method is used. Also, farm real-estate values are usually estimated on a conservative basis and not ordinarily changed from year to year. The first method gives lower deductions from net business gain than the second in any period when farm real-estate values are rising, and because of this includes the capitalization of sizable anticipated increases in farm incomes. We shall discover in Chapter XXXIII on the "Valuation of Farm Property" that most of the time since 1900 the current values of farm real estate have included considerable capitalization of such increases. As a result, labor incomes as commonly calculated by this method have been too low. Only the part of farm real-estate values that represents capitalization of expected current incomes can properly be deducted. The first method, therefore, usually gives more accurate results. In practice, farmers estimate cash rentals fully as accurately as farm real-estate values.

The major difficulty in imputing values for the unpaid family labor centers around the problem of *how much of the work done by family labor would have been hired if the family labor had not been available.* Often family labor is not as fully occupied as hired labor would be and is often employed at less productive work. Consequently, in many cases when the total months of family labor are valued at hired man's wages, the total deduction for family labor is excessive. The exact specifications for value of unpaid family labor are important. The phrase "work for which help would otherwise need to be hired if it were done" may mean something different from "work for which help otherwise would be hired." The latter comes nearer to what is wanted.

Hunt devised labor income as a means of comparing the efficiency of management of individual farms in the same area, practicing about the same kind of farming, and with the same general level of land values

[5] The prevailing interest rate on farm real-estate mortgages is often used.

and cash rentals. It has served this purpose reasonably well. Unfortunately, it is sometimes used for comparisons among regions, and at different levels of agricultural prosperity. Its most serious misuse is as a measure of farm incomes for comparison with urban and other incomes. For such a purpose, it is too low on three counts, aggregating often as much as a half too low.

E. RATE OF RETURN ON THE INVESTMENT This is Net Farm Income, or Business Gain, less an allowance for unpaid family labor and the operator's *labor*, divided by the total value of the farm investment. The rule followed for imputing value to operator and family labor is what the same labor would have cost if hired. The earnings figure thus includes the contribution of the farm capital plus that of the management. This measure is the same as that used in urban businesses except that in trade and industry the compensation for hired management is often deducted before computing the rate of return. This measure is put to the fore in the farm accounting done by the University of Illinois and a large number of collaborating farmers.[6] It looks upon a farming enterprise as an employment of the farmer's capital rather than as an employment of the farmer's management. It measures the rate of return on the capital *with the management thrown in*, rather than the return to the management with the capital allowed the usual nominal 5 per cent as a rental. It varies widely with the amount and quality of the management furnished with the capital, and is therefore in effect much more of a measure of differences in management than of differences in capital. It would be more accurately described as *earnings of management per dollar of capital investment*. This way of looking at a farm business can be realistic, however, in a region like the Corn Belt where many landlords and others look upon farms as investments. The Illinois accounts always figure labor income too so that the farmer or investor may use either measure.

F. OPERATOR'S LABOR EARNINGS This is labor income plus value of family-consumed farm produce and use of the farm dwelling. Professor S. W. Warren says of this measure: "Labor earnings is a better measure of profits than labor income. It is not used as much, because of the difficulty of obtaining accurate information on the amount and value of farm products used in the household." [7] It really includes earnings of management as well as labor.

[6] H. C. M. Case and M. L. Mosher, *Increasing Farm Earnings by the Use of Simple Farm Accounts*, Illinois Bull. 252, 1924.

[7] S. W. Warren, *How to Study a Farm Business*. New York State College of Agriculture, A. E. 396, 1944.

G. FARM FAMILY INCOME If the success of the farming venture is to be measured by what the farm family gets out of the joint farm-family undertaking, three additions are needed to net farm income, namely, the value of the farm products used by the household, the value of the use of the farm dwelling, and any nonfarm earnings of the farm working force. It is possible to organize a farm-family undertaking in such a way as to increase this aggregate without increasing the net business gain of the farming part of it.

H. INCOME FOR FAMILY LIVING The same as G, less payments on the interest and principal of debt on real estate and chattel. These two items should not be included as cash expenses. They are *distributions of income;* not expenses.

Other combinations of these eight are sometimes put together, but these eight measure most of the different kinds of success that farm management is concerned with. The way in which these measures fit together is indicated by the summary on page 494 for a fifteen-cow Midwest dairy farm at 1935–1939 price levels.

FACTORS IN SUCCESS

A common procedure in farm management research and extension work has been to collect data on a group of farms in an area and then see what characteristics of these farms seem, on the average, to be associated with high and low labor incomes or farm incomes. The characteristics most commonly tested are: (1) size of farm business; (2) balance and diversity of enterprises; (3) index of crop yields; (4) returns per $100 of feed fed to livestock, these being measures of yield or outputs; and (5) a miscellaneous list of *efficiency factors* of importance to the particular type of farming.

SIZE OF FARM BUSINESS The relation of net farm income to size of farm business was analyzed carefully in Chapter XIX. Chart 64 in that chapter showed the way in which farm income increases, on the average, with size of business, but also the wide differences between farms in any one size-group. Table 52 showed how putting these figures into a table covers up these differences. The straight line MN is a mathematically determined average for all the incomes. It is a straight line that comes nearest to all the dots in the chart. It can be mathematically determined that only 27 per cent of the differences in income appearing on the chart are associated with size of business measured in terms of farm investment. This means that 73 per cent are explained by some-

INCOME SUMMARY FOR A MIDWEST DAIRY FARM

Net cash farm income, or cash balance		$2.030
Less inventory changes, including depreciation		280
Net farm income, or *net business gain*		1,750
Less imputed values of unpaid family labor		200
Less imputed cash rental of farm, or 5 per cent on imputed value plus interest on livestock, equipment, and working capital, excluding the farm dwelling		750
Labor (and management) income		800
Labor income		800
Plus value of family-used farm products	$420	
Plus net rental of farm dwelling [8]	140	560
Operator's labor earnings		1,360
Net farm income		1,750
Plus value of family-used farm products	420	
Plus net rental of farm dwelling [8]	140	
Plus off-the-farm earnings	220	780
Farm family income		2,530
Farm family income		2,530
Less payments on principal of mortgage	200	
Less payment of interest on mortgage	200	400
Income for family living		2,130
Net farm income		1,750
Less imputed value of unpaid family labor	200	
Less imputed value of operator labor	580	780
Return on farm investment of $18,000		$ 970
Rate of returns on investment = 5.4%		

thing else.[9] Some of the variation is no doubt due to defects in the measure used, and some to nothing more than errors in the income estimates. Five-year averages were used to reduce the effect of irregularities.

It should now be evident that one cannot reason from Chart 64 and Table 52 that differences in sizes of farm enterprises necessarily cause differences in incomes. If the farmers whose incomes appear near or above the line in the chart did not have the capacity to handle farms of the size they are now handling, they would be appearing below the line in the chart. It is as proper to say, therefore, that size of farmers caused the large incomes as to say that size of farms did it. In general, the incomes above the line are for farmers who are above average in

[8] With taxes and insurance out, since paid out of net business gains.
[9] The correlation coefficient is + .536.

efficiency and who are operating farms too small for their capacity; and the opposite of this for the incomes below the line. Consequently one cannot safely lay down a general rule that every farmer should enlarge his farm in order to increase his income. If his income is now relatively low, but above the line, the chances are that he will do well to increase the size of his undertaking. Thousands of farmers, younger farmers especially, can be found fitting this description in the sections with crowded populations on poor land, as in the southern Appalachians, or even on good lands as in the Black Prairie of Texas. But it may also be true that a farmer operating above the line has more efficiency than capacity, in which case, he may already have reached his capacity. On the other hand, a farmer with a low income on a small farm may increase his income by enlarging his business if he runs higher in capacity than in efficiency.

It needs to be stressed again that capacity and efficiency of farmers are not fixed, especially of younger farmers. One of the ways to increase capacity is to learn to operate a larger business by actually doing it. Furthermore, a small increase in size, say from 40 to 60 acres, or from 80 to 120 acres may not increase the management problems at all. Often lack of capital is the important factor limiting the size of farm operated.

BALANCE AND DIVERSITY OF ENTERPRISES Those interested in correlating measures of success with factors in success have also commonly sought for some statistical measure of enterprise combination that could be used in such analysis. In areas that are largely specialized in one crop, like cotton, the procedure commonly followed has been to figure the average labor incomes of farms grouped according to the percentage of their cropland in cotton. Usually the groups with the highest percentages in cotton have had the highest incomes except in periods of very low cotton prices. Similar results would be obtained for potatoes, tobacco, or wheat when grown in specialized areas.[10] These correlations are presented to the farmer to emphasize the importance of increasing his acreage of the high-income crop as much as possible. Usually, however, the statistical results are only partly valid. Much of the correlation is often due to the fact that the farms with the most land in cotton, potatoes, or wheat are those with the most productive land. The table, therefore, may mainly measure the effect of differences in the quality of the land. The second qualification of these statistical results is that they do not take account of the longer-run effects of single-cropping on the land.

[10] William E. Schrumpf, *A Study of the Organization and Management of Potato Farms in Aroostook County, Maine,* Maine Bull. 378, 1935. See Table 60 for an example of such analysis.

In farming regions already diversified, the measure sometimes used is simply to count in the number of enterprises contributing 10 per cent or more of the farm income.[11] Analysis in these terms often shows that the farms with the most enterprises make the most money. Such results may be entirely valid, showing the effect of fitting enterprises together in such a way as to provide a fuller use of labor and other resources of the farm. They may fail, however, to allow for the fact that high diversification makes heavy demands on managerial capacity and efficiency, and that the farms now with four and five enterprises are pretty certain to be in the hands of persons of high managerial talents. These same farmers might do still better by concentrating these talents on larger but fewer enterprises, and those with two or three enterprises might well lose out by dividing their efforts among four or five. The wise procedure for a farmer with two or three enterprises is to do as good a job as he can of pre-estimating the effects on his receipts and expenses of adding a new one and then trying it out a few years before adding still another enterprise. Several hundred thousand farmers have tried out soybeans or peanuts in this way in the past ten years.

TABLE 58. BALANCE OF ENTERPRISES ON ILLINOIS ACCOUNTING FARMS, NORTHERN TWO THIRDS OF STATE, AVERAGES OF 1926–1935

	Cash-grain — $\frac{2}{3}$ cash-grain and $\frac{1}{3}$ livestock	*Crop-livestock — half of each*	*Feed-livestock — hogs dominant*	*Feed-livestock — beef cattle dominant*	*Feed-livestock — dairying dominant*
Acres per farm	267	236	219	277	178
Farm investment	$47,300	$46,200	$38,900	$53,900	$31,700
Total receipts	4,480	3,920	3,760	5,890	3,360
Return on investment	1,880	1,490	1,100	1,890	870
Rate of return — per cent	4.0	3.6	2.8	3.5	2.8
Per cent of land tillable	91	88	83	84	80
Per cent tillable land in corn	42	40	39	39	33
Per cent tillable land in hay or pasture	16	22	28	31	36
Return per $100 feed fed	128	139	133	133	159
Month's labor per 100 tillable acres	9.0	10.4	11.9	10.9	15.4

Source: Adapted from Table 19, Illinois Bull. 491.

[11] Dr. W. J. Spillman developed a more precise index in which the relative importance as well as the number of products is included. See Cornell Bull. 551, p. 16, 1933.

The Illinois Experiment Station has made the interesting statistical comparison shown in Table 58 of the balance of enterprises on its accounting farms in the northern two thirds of the state. The farms selling cash grain mostly had the largest return on their investment, and per acre of land, but they had the most tillable land. The farms feeding all their crops to dairy cows especially were a third smaller in acres and a half smaller in tillable acres. By getting $159 of return per $100 of feed fed, however, compared with around $135 for the other farms, they managed to make up in some measure for their smaller resources. The beef-cattle farms were buying a good many feeders and stepping up their incomes in that way. One could scarcely conclude from this table that any one of these five groups of farms would do better to shift to one of the other systems of farming. Clearly, the determination must be an individual one depending upon the special circumstances in each area and on each farm.

CROP-AND-LIVESTOCK-YIELD INDEXES These are measures of rates of production. They may be expressed for single products, like yields per acre, or output per cow, or combined into indexes. The crop index for any farm measures the average yield of its crops compared with that of the area, which is called 100. Thus an index of 110 means that *yields on this farm are 10 per cent above the average for the area.*[12]

The tables prepared generally show that the farms with the highest crop indexes have the highest labor or farm incomes, and from this the rule is formulated that farmers must improve their yields in order to gain higher incomes. The principles involved in this have already been thoroughly discussed. It has been made clear that most farmers are producing well to the left of their highest-profit point, and many even to the left of their least-cost point; but that what these tables mainly show is that the better farmers own the better farms, obtain the higher yields, and also have the higher incomes. The farmers on poor lands generally find their most advantageous yields at much lower levels than those on the first-class lands. In fact, it is virtually impossible for the cotton growers at the left end of Chart 71 to obtain the yields shown at the right end of the chart. The farmers anywhere along the line from left to right may gain from adopting practices or methods that will give higher yields, but one cannot know this from the chart; nor from a table that would show the average net income per acre for these farms put in five groups as indicated on the chart. The stars on the diagram

[12] In computing such an index for an area or a farm, the different crops are weighted according to their importance in the area.

indicate the midpoints for these groups. Crop-yield indexes are associated in this chart with 40 per cent only of the differences in net income per acre. This is true even though they are based on five-year averages.

Even if the evidence seemed clear that higher yields would increase net incomes on any farm or group of farms, the operators would still need to choose among different methods of raising yields. This would call for matching the additional cash outlays of different methods against

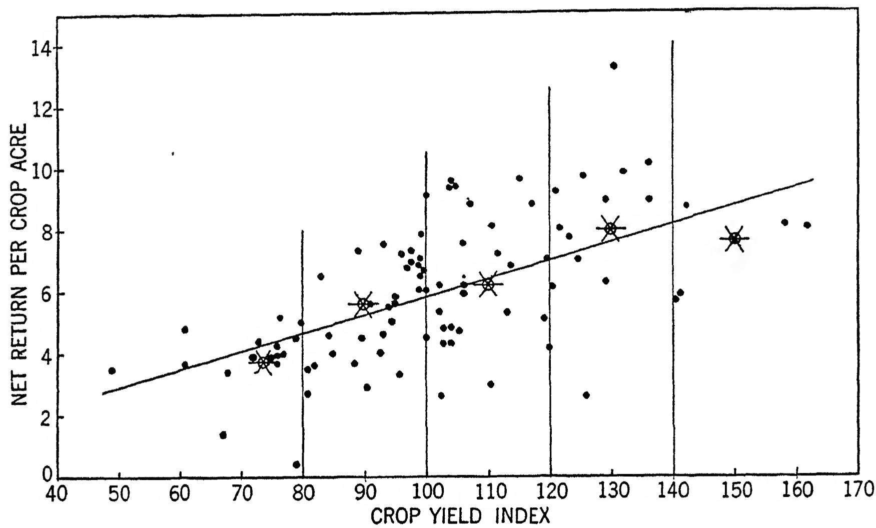

CHART 71. Net returns per acre associated with 5-year average crop-yield indexes on 91 cotton farms in Texas, 1931–1935. (The data foı this chart were furnished by C. A. Bonnen of the Texas Agricultural Experiment Station.)

additional yields expected, to find which promised most, and also to discover the last input which just paid for itself.

Five-year averages for wheat farms in central Kansas, in the Wichita Prairie area (Kansas type-of-farming area 6b), when analyzed like those in Chart 71, produced the results shown in Chart 72. The scatter is much greater in this chart — in fact, only 15 per cent of the differences in net farm incomes per acre are associated with yield-index differences. Yet the stars which represent the averages that would appear in a table appear to rise in fairly regular order.

The livestock-yield indexes comparable with the crop-yield indexes may be simple percentages of the average production per cow or sow or hen in the area, or an attempt may be made to combine these into a weighted index. The correlations obtained are of the same order as those for crop indexes and subject to the same qualifications. As with

crop yields, a statistically derived average line or curve for an area will not serve as a guide for any one farm. The poorer cows will of course show a different response to efforts to increase outputs than the good ones, and will reach their highest-profit points sooner; similarly, a dual-purpose herd than a dairy-type herd.

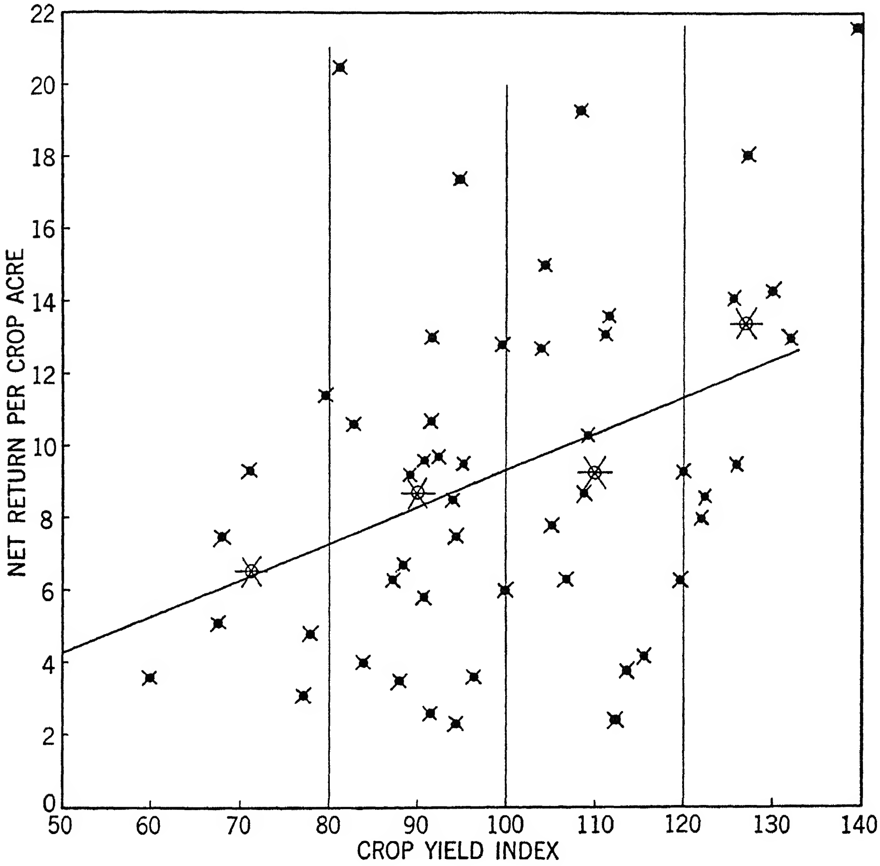

CHART 72. Net returns per acre associated with 4-year average crop-yield indexes on 50 wheat farms in central Kansas, 1941–1944. (The data for this chart were supplied by J. A. Hodges of the Kansas Agricultural Experiment Station.)

EFFICIENCY FACTORS OR COEFFICIENTS These are sometimes output-input ratios, or coefficients, like livestock or livestock-product sales per $100 of feed, or they are simply ratios between input factors, like crop acres per man. In the latter case, they are sometimes called *operating ratios*, or *organization factors*.

Efficiency factors such as crop acres *per man*, *per horse*, or *per tractor* have been used since the earliest farm management studies. Usually the farmers with higher than average incomes have higher than average crop acres per man or per horse. Actually, crop acres per man is also affected by the amount of livestock kept on the farm and the labor inputs of the different crops. Its usefulness is limited to comparisons between farms having similar cropping systems and livestock numbers. Insofar as it measures efficiency of labor use, it varies with how carefully a crop is tended, with how much power and machinery is used with the labor, and with the size of the farm. Crop acres per horse or per tractor are affected in the same way.

This type of measure must be used very carefully. It is extremely easy to misinterpret the results in certain types of situations. Given an apparent oversupply of family labor, a family may decide to add small acreages of intensive crops like sweet corn for a canning factory, or cucumbers for a pickling station. On the farm on which the senior author was reared, one acre of small fruit for the local market gradually grew into five as the family became older and could do more work. Surveys frequently show a larger proportion of the acreage in corn, cotton, and other intensive crops on farms with family labor than on those with hired labor. They also show more cows milked and fewer hogs sold. The crop-acre coefficients are lowered by such crop and livestock combinations, but the net income of the farm is increased. To attempt to raise these coefficients by reducing the acreage of intensive crops would reduce the net farm income. A high figure for crop acres per horse or per man may be due to fitting the land inadequately, or to fewer cultivations or sprayings, resulting in reduced yields, instead of a more effective use of man and horse labor. Such coefficients are therefore not safe guides until refined so as to take account of the differences in the intensity of the application of the factors.

Professors Warren and Scoville of Cornell consider *work units per man* and *output units per man* the two best measures of man-labor efficiency. The first is computed by dividing the number of productive man-work units by the number of persons employed on the farm, these latter being expressed as adult-male equivalents.[13] The output units of a farm are computed by multiplying the outputs of the farm by the average labor used in the area for a bushel, hundredweight, or ton of the different products. Such a figure differs from the total man-work units of the farm only in that the latter are figured per acre, per cow, etc. In effect,

[13] G. P. Scoville and S. W. Warren, *Labor Requirements for New York Crops and Livestock*, New York State College of Agriculture, A. E. 462, 1943.

the two measures use two different systems of weighting, yields entering into one and not into the other.

The advantage of these two measures is that they take account of differences in the labor needs of different crops, and they also include the labor on the livestock. Therefore they are a great improvement over crop acres per man. However, they are still subject to some of the same dangers of misapplication. A farmer could easily make changes that would increase his work units or output units per man and at the same time reduce his income undesirably.

Coefficients of the foregoing sort fill a definite need if properly used. Many farms are oversupplied with horses. Even more are over-equipped with machinery. Farmers who can afford it have an inclination to add new horses or tractors or other equipment to their farm organizations without disposing of that already on hand. Given such over-equipment, the only ways to raise the coefficients are to enlarge the scope of farm operations or to dispose of the surplus equipment. Coefficients like crop acres per man also often indicate that farms really have a surplus of labor, particularly of family labor. Sometimes the several sons of a farm family larger than average remain on the home farm and are not fully employed. This may be highly commendable from other points of view, but it means reduced output per worker and income per family.

Professors Case and Mosher of the University of Illinois use 23 different measures of livestock efficiency as related to rate of return on total investment on central Illinois farms.[14] They attach most significance to *returns per $100 of feed fed to different classes of livestock*, *crop-yield indexes*, *feed fed per acre*, *a livestock-efficiency index*, and *a price index*. The first of these varies with the system of livestock management and needs to be worked out for each separately. Feed fed per acre is a rough measure of the balance between crop, pasture, and livestock. It is, of course, affected by the proportion of the land kept in permanent pasture and differences in crop rotations. The livestock-efficiency index is weighted according to the amount of feed normally fed to each kind of livestock. It varies widely between short-fed and long-fed cattle, raising and buying feeders and replacements and the like. The price index attempts to compare the price which each farmer gets for his livestock and livestock products with the average price received by all the farms studied.

Indiana has attempted to meet the difficulty of varying feed-output ratios by types of livestock and systems of management by using an

[14] M. L. Mosher and H. C. M. Case, *Farm Practices and Their Effects on Farm Earnings*, Illinois Bull. 444, 1938.

average with the following weights: dairy cattle, 1.67; beef-breeding cattle, 1.43; fattening cattle, 1.19; hogs, 1.18; sheep, 1.43; and poultry, 2.00. These differences arise from differences in the amounts of labor and other input factors that go with the feed in Indiana farming.[15]

In its farm accounting work, Kansas has separate coefficients for cattle and hogs, expressed in terms of *receipts per dollar invested.* For machinery, it uses *machinery investment per acre.*[16] Oklahoma very appropriately calls its coefficients *organization factors.* They include such as the following: *Investment per acre, gross receipts per acre, net receipts per acre, animal units per 100 acres, feed crops per animal unit.*[17]

On feed-livestock farms very useful measures are *T D N's per acre*, or *pasture acres per cow*. Such coefficients need, of course, to be fitted to the type of farming. Professor E. G. Misner of Cornell lists eleven possible coefficients to use on dairy and general farms, seven on poultry farms, four on fruit farms, and five on vegetable farms.[18] No attempt is usually made to correlate these efficiency factors directly with labor or farm incomes, but it is usually assumed that they are so correlated.[19]

Finally, we need to consider briefly the uses of these coefficients. Commonly they are set up as "standards of good performance." Farm management surveys made in an area furnish the basis for figuring average coefficients that are offered as guides to the farmers in the area in judging the effectiveness of their own organizations and operations. So used, they are of course subject to all the qualifications and misinterpretations outlined above. There is the further difficulty that an average is ordinarily not a sufficiently high goal to set for really good performance — it includes as much bad performance as good performance. Sometimes, however, this difficulty is met by taking the average of the ten best farms in the area. This introduces the other danger that many of the farms in the area will not have as good land or as good cows, or for that matter as good managers, as the best ten farms, and their points of highest-profit combination may fall well below the average

[15] Lynn Robertson, *Importance of Different Farm Management Factors under Varying Price Conditions in Northwestern Indiana*, Purdue Bull. 452, 1940.

[16] J. A. Hodges, L. M. Schruben, L. B. Harden, *Summary of Results on 86 Farms in Farm Management Association No. 4, 1940, Northeast Kansas*, Kansas, 1941.

[17] Leslie F. Stice and E. D. Hunter, *Annual Farm Business Report to Twenty-four Record Keeping Farmers in Oklahoma Type-of-Farming Area IX, 1940.* Stillwater, Oklahoma, 1941.

[18] E. G. Misner, *Thirty Years of Farming in Tompkins County, New York.* Cornell Bull. 782, 1942.

[19] William E. Schrumpf in *A Study of the Organization and Management of Potato Farms in Aroostook County, Maine* (Bull. 378, 1935) correlates four efficiency factors with labor income — acres of potatoes per man, acres of potatoes per $100 invested in tractor power (tractor plus horses plus trucks), potato machinery per acre, and capital turnover. Such coefficients are obviously more meaningful on specialized than on mixed farms.

for the best ten. Standards of good performance therefore really need to be adapted to the particular circumstances on each farm. Farm management extension workers who make use of such standards are ordinarily in a position to make such adaptations, at least in rough-and-ready form.

EXERCISES

1. Compute the *labor income* of some farm with which you are familiar: (a) using the cash-rental method of determining the deduction for the contribution of the farm and working capital; (b) using the method of applying the prevailing interest rate on farm mortgages to the correct value of the farm and working capital. If a difference appears, explain it.
2. Compute the value of unpaid family labor on the following three bases: (a) What would have been paid for hired workers of the same age and work capacity working for the same periods. (b) The amount paid for the labor which the farm operator would have hired if family labor had not been available. (c) What the unpaid family workers could have earned at other jobs that were available to them while still living at home. Which is the proper deduction in computing labor income? farm operator's labor earnings?
3. Compute for at least one farm all eight of the income measures defined in this chapter.
4. Construct a scatter-diagram chart like Chart 64 from data supplied by your instructor from some farm management survey, or groups of farms keeping accounts, in your state. Also construct a table, like Table 52, for these data.
5. Each member of the class select some farm which is well above or below the line and study the survey blank or farm account book for this farm to see if he can account for its position; and then suggest what lines of action would best promote an increase in farm income.
6. In your home community, are the most specialized or the most diversified farms prospering most — in the short run? in the longer run?
7. Compute crop-yield indexes, or livestock-yield indexes, for a group of farms in an area in your state, from data supplied by your instructor. Account for the differences in the indexes in terms of factors discussed in the chapter.
8. Compute as many of the efficiency factors as are appropriate for one farm for which your instructor supplies the needed data. Compare your coefficients with those obtained by other members of the class, and account for the differences. What changes for your farm would you suggest on the basis of these comparisons?

CHAPTER XXIII

Accounts, Records, and Surveys

THIS CHAPTER WILL DISCUSS FIRST THE ACCOUNTS AND RECORDS WHICH farmers may keep by themselves, and second those which they may keep in collaboration with public agencies, or for which they may supply the information in surveys and the like.

Not long since, few farmers in this country kept accounts at all, or kept anything more than an occasional record of some transaction that they feared they might not keep in mind clearly enough. The checking accounts which many of them presently began keeping provided them with much more of a record than they had had before. Within the last ten years, however, and especially within the last four, the income tax statements which they have had to prepare have induced large numbers of them at least to record their financial transactions. Some have added inventory statements so as to be able to figure their income taxes on an accrual basis rather than on a cash basis.

The leadership and assistance furnished by the agricultural extension services have furnished much impetus to the movement toward keeping fuller and better records. The account books now distributed in most of the states provide not only for an orderly recording of all receipts and expenses, but also a procedure for figuring a net worth at the end of each year that can be compared with that of previous years. The farm family can thus see in definite terms the financial progress which it is making. To have such a statement each year has a strong appeal to business-minded farmers. An increasing number of farmers are also keeping production and feeding records for their different crops and livestock so that they can compare their inputs and outputs and efficiency factors with those of preceding years, and obtain data for their farms that they can use in farm budgeting and planning.

It is not here assumed that all farmers should keep full records of all their business transactions and all of their farm operations. Only the simplest records may be worth while on the million or two of the small one-crop farms of the South, or on the largely self-sufficing farms of the

mountain regions; or, though the accounts would be worth while, the family may not be equipped to keep them without more help from the extension services than the public treasury can stand. Only on the larger farms is it worth the effort involved for farmers themselves to keep detailed records of all the labor and other inputs on all the farm operations. Experiment stations may find such records on a limited number of farms highly useful in research, but in this case they will need to contribute part of the effort. The procedure followed in this chapter is to consider first the types of record that are more nearly essential for all farmers to keep, and last the types of record that are worth while only on highly commercial farms or for research purposes.

The records ordinarily kept by or for farmers are usually distinguished as *financial* and *operating*.

FINANCIAL RECORDS

A PERMANENT RECORD OF THE FARM AND FARM-FAMILY TRANSACTIONS

Any family — farm or other, for that matter — should keep a written record, with the dates, of all the major transactions in which it is involved. This should include purchases and sales of farms and of other major property items, leases and other contracts entered into, borrowings, rentings, repayments, and the like. It is true that most of these transactions will be matters of record on bank statements, or on stubs of checks, if the family has a checking account; but not enough of the attendant circumstances are recorded with them. Moreover, it will be difficult to get them together if the head of the family dies unexpectedly, or if other need for a legal settlement arises.

This record can be kept in a simple daybook or journal, with one column for the date, a wide middle column for the item, and a third for any sums of money that may be involved, the entries being made in chronological order.

CASH RECEIPTS AND EXPENDITURES Preparing an income tax statement on a cash basis for a farm business requires in addition to the above a record of all the farm receipts and farm expenditures in day-to-day entries. A simple daybook or journal is all that is required to do this job completely. The items can later be classified to suit any purpose. Classifying them as they are entered in separate ledger accounts does not usually work out well in practice, but a number of farm account books are available which provide for this.

If the family side of the farm-family combination is operating on a budget basis, the expenditures on family living will need to be entered

also, but these usually should be kept separate from the farm expenditures.

INVENTORY STATEMENT Several uses of accounts require the making of opening and closing inventories. First of all, the farm will need these inventories in order to figure its Net Worth at the end of the year and its Business Gains or Losses. Second, inventories of feed and supplies are necessary in order to set up budgets and feed distribution statements such as presented in Chapters XI and XII. Third, if the family is making its income tax statement on an accrual instead of a cash basis, it will need, in addition to the record of receipts and expenditures, an inventory of all of the livestock, workstock, and machinery and equipment on the farm, and also of the feed and forage on hand, and a record of *accounts receivable* and *accounts payable*, that is, of money due to be received and money due to be paid out.

Such inventory statements can be prepared in the pages of any ordinary daybook or journal, but it is convenient to have the opening and closing values, and often those of several succeeding years, listed in parallel for comparison.

Two major problems of valuation are involved in making inventories. One is the amount of depreciation to allow. This subject is discussed in Chapter XXIV. The second is how to handle changing prices. The rule is to use the same prices in both opening and closing inventories so that only real increases and decreases will be counted. Increases should appear for acquisitions during the year, for growth of young stock, for building and land improvements, and for increases in stocks of feed and supplies, and decreases for sales of livestock, depreciation of buildings, fences and livestock, and decreases in stocks of feed and supplies. The valuations for these items are usually carried forward from year to year at the same rates, so that no gains or losses are produced by changing price levels. If a farmer at any time decides that he wants to convert his inventory values to a new level of prices that appears to have come to stay for a while, he will need in that year to revalue his opening inventories to match his closing ones.

NET WORTH AND OPERATING STATEMENTS Given these inventory statements and a record of cash receipts and expenditures, the farmer is in a position to prepare, at the end of each year, a balance sheet showing *assets* and *liabilities*, *net worth*, and changes in net worth for the year, and likewise an *operating statement* in the manner indicated in Chapter II. These two statements not only give the farmer a more precise summary of his financial position and of the progress which he

has made during the year than he is likely to have without them, but they also enable him to see which of his receipts and expenditures have increased and which decreased compared with earlier years, and thus to obtain a clearer understanding of the factors affecting his progress.

OPERATING RECORDS

The operating records kept on any farm can vary over a very wide range of detail, depending upon how careful a job the farmer wants to do in analyzing his past operations and in planning for the future. The records which return the most for the effort put in are simple field records and livestock feeding and breeding records.

FIELD RECORDS The main purpose of field records is to show the performance of the different fields over the years as affected by the cropping, pasture, and soil management program, this to furnish a basis for projecting yields and setting up budgets. Full field records should show, for all the cropland, the crop grown on each field each year, the amounts of lime, manure, or other fertilizer applied, the crops plowed under, any special data about the fitting of the land each year, the dates of planting or seeding and harvesting, and of course the yields. They may also want to show the dates of cultivations and sprayings. They will also record the number of cattle pastured, if the field is pastured in rotation. The dates make it possible to see the relation between the date of planting and yields and to observe how the work on the different crops fits together over the year. If the region is one which is subject to local thunderstorms or local frosts, it may be worth while to record these.

The first step in the keeping of field records is to make a map of the farm which shows the boundaries and correct acreages of the different fields. If a field reported as ten acres has only nine acres in it, the yields will be 11 per cent off.

Ordinarily a farmer will not have a long enough record on any of his fields to project yields with different rotations and treatments with any high degree of accuracy, or even to make it worth while to do any close figuring with them. He may be fortunate enough to have the results of some experiment station trials to give him general guidance. For example, if in these trials, the plowing under of a crop of vetch raises cotton yields 30 pounds per acre on Sharkey Clay Loam, he may reasonably count on a major part of the same effect on his Sharkey Clay Loam soils, even though his yields average lower than those at the experiment station. Statistical averages for a whole state, or even

for an area, of the effects of practices on yields such as discussed in Chapter XXI, are not likely to fit his farm very well, but can be weighed in along with the results on his fields. Given data of this sort, he can weigh marginal costs and returns each year after his crop is harvested or sold, and each year project the highest-profit point for the new crop with more assurance.

LIVESTOCK RECORDS Full livestock-feeding records require that the feed for the different kinds of livestock be weighed at frequent intervals, that the milk be weighed regularly — at the extreme, at each milking — and be tested for butterfat occasionally, and that the weights of meat animals be determined at the beginning and at the end of the feeding period, and perhaps at regular intervals during the feeding period. From such records, it is possible to determine output or gains in weight per unit of feed, grain and roughage separately if desired, and conversely, feed input per unit of output or gain in weight. Gains in weight can be expressed as a rate per day or week as well as per unit of feed. The results thus obtained can be compared with those of previous years and with those of other lots of livestock; also with standard rates of feeding such as one pound of grain for 3 to 4 pounds of milk depending upon its butterfat test. If the farmer is interested in more careful measurement than this, he can convert the feed inputs to T D N's and separate the production from the maintenance ration; and similarly for proteins.

Most farmers, however, will not have scales available for the weighing of livestock at the beginning of the feeding period and will need to estimate the weights except for feeders bought in the market. They are likely also to do a good deal of estimating of the feed. What many of them do is to estimate the division of the total feeds produced on the farm among the different kinds of livestock or lots of livestock, and do the same for any feed purchased. The results obtained in this way may be somewhat wide of the mark and may need to be checked in various ways before they can be of much value.

One way of checking feeding records is, of course, to calculate their T D N's according to the Morrison or some other standard and to match these against the maintenance requirements plus the production requirements per unit of output or gain in weight. This procedure is too cumbersome to be used by most farmers, but not by extension economists working with farmers, nor in research analysis. When feeding records are thus checked, the estimates commonly prove to be too high because of forage wasted, and often because the feed values in the

roughage are reduced by damage from rain or from becoming too ripe or because the hay contains weeds. The deficiencies commonly range around 10 to 15 per cent. For budgeting purposes, however, the feed records do not need to be highly accurate provided the estimates are made the same way each year.

For dairy herds, records kept by individual animals are very useful in helping to cull out the least profitable cows. The types of records which have been worked out very carefully by the dairy-herd-improvement associations include feed consumption as well as milk and butterfat production. These records are often found inaccurate too. They need to be checked against feed supplies and their distribution whenever possible.

PASTURE RECORDS These would be more difficult than the barn-feeding records, if an attempt were made actually to measure feed intakes, since there is no practical way of determining how much actual grass is eaten by livestock. The records kept, therefore, merely report the number of head of livestock by ages and perhaps estimated weights which are kept on a pasture lot and for what periods; and if perchance some farmer does undertake to determine the amounts of the pasture feed obtained, he figures it backward from the milk produced or the gains in weight. Pasture feed is commonly stated in terms of the carrying power of the pasture. Such figures show the productivity of the pastures, not that of the animals or feed. They can be compared by years and with certain averages or standards and used directly in the setting up of budgets.

Given livestock, feed, and pasture records, a farmer can also compute any of the livestock-efficiency coefficients described in Chapter XXII and compare them with averages or other standards that may have been figured out for his area.

LABOR RECORDS The keeping of detailed labor records adds considerably to the task of business management. On the ordinary family farm, the most important use of labor records is to show the period during which labor is employed at different operations on each crop, so as to furnish a basis for planning labor distribution and for fitting crops together so as to prevent conflicts. Such information can be included in simple field and livestock records instead of special labor records, or since it is likely to be much the same on all farms in the area, provided by the extension service. Similar records suffice for horse labor and tractor labor.

A full man-labor record would include a report of all the work done each day on each field crop and on each class of livestock, and the general overhead labor on farm upkeep and the like. Given such records, a farmer could compute the total hours of man labor per acre or per head of livestock or per unit of product; or even the labor inputs per unit of product. He could even figure out his total man-work units. Such figures can be compared year by year, by crops and by types of livestock, and also with area or state averages. They can also be used for comparing the labor inputs of the different crops and kinds of livestock, although such comparisons are not of much significance except as a general measure of the relative amounts of labor used by different farm products.

In planning farms, the time of year when the labor is needed is often a more important consideration than the amount of it. More useful than labor inputs in constructing budgets are data in the form of number of cows or head of beef cattle that one man can handle, or the number of acres of corn that one man can take care of with different tractor or workstock outfits.

On large farms, where much labor is hired and the tasks of the different workers are specialized to a considerable extent, data on standard performances can be used as a check on the work done by different workers. It is even possible to base rates of pay on such performances, as is done in many factories.

MONETARY UNITS All of the production and operating data provided for in the foregoing sections are in physical units. They are adequate in this form for the ordinary needs of planning farm organizations. A number of the efficiency factors described in Chapter XXII, however, require converting these physical units to money terms. Value of product per $100 of feed, for example, requires that all the feed fed, including silage and corn stover, be reduced to value terms. This is commonly done in surveys of groups of farms by applying uniform rates on all farms. Or an attempt may be made to compute pasture costs by figuring 5 per cent of the estimated value of the pasture land and adding fencing and other upkeep costs. Such measures of feed costs per hundredweight of milk, or hundred pounds of gain in weight of hogs, have the advantage that they combine the different kinds of feed into one measure. Unfortunately, however, when the results thus obtained are compared with those of other years or seasons, or with averages, they are affected by the particular prices paid for the feed at the time. Comparisons in terms of T D N's are not thus affected.

Gross value of product per acre of different crops may be figured by assuming market prices for the marketable crops and imputing values to the rest. Net value of crops per acre can be obtained only by assigning values to all the labor and other input factors used on each crop. This is feasible and useful on large farms where most of the labor is hired and is paid a specific rate for a specific task. But, as explained elsewhere,[1] if it is attempted on ordinary family farms, the cost-rates for labor must vary according to the competition for labor at the times of the year when it is used on any crop; otherwise the results may make some crop or class of livestock appear to have a low net value which nevertheless increases the net farm income.

Sometimes labor use is converted to a monetary basis by applying a uniform rate per hour to the labor used on all the different crops and livestock. Such results can be expressed in terms of gross returns per hour. These tell us nothing more, however, than hours of labor per acre, or per cow, or per hundredweight of milk, since they are obtained by the simple arithmetic of applying flat rates per hour and taking the reciprocals. Net returns per hour of labor, if valid, are more significant, but they require applying cost-rates to all the feed and other input factors; also making an allowance for the manure produced by the cows, the skim milk fed to hogs, and the like.

RECORDS AND ACCOUNTS KEPT WITH PUBLIC AID

The discussion in this chapter so far has assumed a farmer keeping his own accounts and records and making his own analysis and interpretation of them and also applications of results. In this and several European countries — notably Germany, Switzerland, Denmark, England, and Scotland — a large amount of record-keeping and farm accounting has been done jointly by the farmers with public agencies or with farm organizations which have affiliations with the governments.[2]

SUPERVISED ACCOUNT BOOKS The 1931 Yearbook of Agriculture reported thirty-one state colleges supervising the keeping of farm account books in their states. The number of states has increased since, and still more the number of farmers participating. Thus Illinois, which began this service in 1915, was helping with 894 account books in 1926 and 1,847 in 1937; and Iowa with 705 in 1930 and 1,198 in 1940. To the

[1] See Ch. XXV.

[2] The local chambers of agriculture in Germany were supported in part by public funds. The Swiss Farmers' Union performs several public agricultural functions. The Illinois Agricultural Association is affiliated with the state agricultural extension service through the County Farm Bureaus.

Illinois figure should be added the accounts kept with the Farm Bureau Farm Management Service, which number around 1,900 at present, starting from zero in 1924.

The T V A induced a great expansion of this program when it began giving financial support to the keeping of such accounts on the "test-demonstration farms" (farms testing the use of phosphates) in the Tennessee Valley counties of seven states, and to a lesser extent in some other states. Tennessee alone in recent years has been keeping around 3,000 account books with test-demonstration farmers.

The states in each case furnish the account books and field men to help with making the opening and closing inventories. The field men for the Farm Bureau Service make three or four visits to each farm each year, to return the books, to present the subsequent annual summary of the account books, to show each farmer how his income compared with others in his class, and to help the cooperators with their farm organization problems. One field man works with 200 to 235 farmers. The entire cost of this intensive service is from $30 to $40 per farmer per year, of which the farmer pays the major portion. The assistants to the county agents who help with this work in the Tennessee Valley counties handle only about fifty farms, but they have other duties. In most of the states, the service is not as intensive as in these two instances.

The account books may call for little except inventories and receipts and expenses, in which case the annual summary is a purely financial statement; or they may, like the Illinois Farm Bureau books, call for recording the production of milk, eggs, and wool, the live weight of livestock sold, the production, purchases, and disposition of all feeds, and farm practices, in which case considerable analysis is possible in terms of factors in success and efficiency factors.

The participating farms in the Farm Bureau Farm Management Service in Illinois, and similar associations in several other states, are organized into "farm accounting associations" which elect officers, hire their field men, and give guidance to the work.

The farmers keeping these account books are mainly the larger and more prosperous farmers. In Illinois, "the average earnings of the lower one fifth to one third of the account-keeping farmers are about equal to the average earnings of all farmers in the area." [3] They are thus a group of business-minded farmers who like to see a balance sheet of each year's business. It is important, of course, that this balance sheet be authentic. The principal value in the accounts for these farmers,

[3] M. L. Mosher, "Thirty Years of Farm Financial and Production Records in Illinois," *Journal of Farm Economics*, February, 1945, p. 25.

however, is that the keeping of the records makes them do more thinking and figuring about their farm businesses. The major value of this work from the standpoint of the agricultural college is not in any conclusions drawn from data gathered, but in that it provides a close working contact with a group of the more successful farmers in the state.

FARM BUSINESS SURVEYS The method of supervised accounts seems to have developed in this country out of the method of "farm business surveys," which consists of visiting the farms once, or once a year if the survey is repeated, and getting opening and closing inventories and receipts and expenditures all at one time. When the Illinois College of Agriculture used this method in Illinois in 1913, it found that the Illinois farmers could not remember well enough the large quantities of grain and feed on hand on January 1st or some other date of the year before, nor their numbers of livestock, nor their receipts and expenditures.

The survey method, however, was more widely used than the supervised-account method until sometime in the 1920's. The 1931 Yearbook of Agriculture reported 33 states as having made one-year farm-business surveys in 217 areas, and 10 states as having made repeat surveys in 23 areas.[4] The first survey was made in Tompkins County, New York, where Ithaca is located, beginning in 1906 by George F. Warren, and reported in Cornell Bulletin 295 in 1911. W. J. Spillman adopted this method for the Office of Farm Management of the United States Department of Agriculture. Its first farm survey bulletin covered four townships in southern New Hampshire and was published in 1911.[5] The technical difference between the survey method and supervised accounts, as pointed out by Professor S. W. Warren, is that in the one case each farmer keeps his record to suit his own fancy, whereas in the other case each farmer keeps a standard set of accounts.[6] He could have added, however, that in the first case a majority of the farmers kept no record at all in the days when surveys were being widely made. Today with bank statements and income tax statements commonly available, the records are very much better. As late as 1923–1925, the incomes reported in farm business surveys and the expenditures reported by the farm and family showed wide discrepancies in areas surveyed in Minnesota and Ohio.

[4] *Yearbook of Agriculture, 1931*, p. 984*ff*, and *Yearbook of Agriculture, 1933*, p. 711.

[5] E. H. Thompson, *Bureau of Plant Industry*, Circular 75.

[6] S. W. Warren, "Forty Years of Farm Management Surveys," *Journal of Farm Economics*, February, 1945, pp. 20*ff*.

The farm business survey became highly standardized by 1913. Its data were all pointed toward computing a "labor-income" figure and showing the correlation of labor income with size of farms, crop yields, production per animal, and one or two other factors. As pointed out in Chapter XXII, such correlations overlook other reasons for differences in income fully as contributory as these. Data do not need to be highly accurate, provided the errors do not run mostly one way. Neither is it necessary to include all the causal factors. But those left out must not produce effects mostly in one general direction.

The most important values in the farm business surveys have been the facts about actual farming and the insight into its problems that have been gained by those who have made the surveys, and these values have not been well reported in the published bulletins. The surveys, therefore, should have been made more generally by those who actually taught farm management or conducted extension work.

A distinction needs to be made between the survey method as such, which is a general method which can be used for collecting data on almost any subject, and the particular use of it in farm business surveys that was developed in this country before 1925. The survey method as such has wide possibilities of usefulness in farm management research.

THE ROUTE METHOD The route method [7] of collecting data from farmers was developed at the University of Minnesota by W. M. Hays, Andrew Boss, and T. P. Cooper in 1901–1912. (The first report was published in Minnesota Bulletin 97 in 1906.) The method was used in collecting data that could be used in computing unit costs of production. The survey method had not yet been developed, and if it had, would not have provided the detailed records on use of man and horse labor and feed that seemed necessary in calculating unit costs.[8] On the early cost routes, the field man spent three days a month on each of eight farms and recorded the milk, eggs, and other products actually produced or sold, the feed fed to each class of livestock, and the working time on each field operation or other farm activity. The milk and feed were actually weighed on these three days. The unit costs were computed in the central office maintained at the experiment station. The cost routes at the University of Minnesota are now under the direction of

[7] Andrew Boss, "Forty Years of Farm Cost Accounting Records," *Journal of Farm Economics*, February, 1945.

[8] The survey method has often been used since in estimating costs of production of farm products. W. J. Spillman used it for estimating wheat costs in 1917, and the U. S. Tariff Commission in 1921–1928 for estimating the costs of wheat, butter, sugar, tomatoes, "live bob-white quail" and several other products.

Professor George A. Pond. As with the survey method, the route method must be considered as a general method of collecting data, to be preferred whenever accuracy of detail is needed, and not as identified with the particular use of the data collected.

THE CASE METHOD The case method as applied to farm management studies differs from the route method in that it undertakes to arrive at a full understanding of the management problem of each farm analyzed. A case-method study of farming in an area includes the following steps: First, exploring the area and deciding what are the management problems of the area. Second, deciding what data and information are needed. Third, on the basis of A A A records, assessor records and the like, classifying the farms in the area and selecting the farms to be analyzed in each class. The selection of the farms can be deliberate or at random — the purpose of the study will determine which. Fourth, collecting data for the farms selected by the route or survey method or any combination of these that will serve best. Fifth, studying one farm in one class as a unit and endeavoring to understand thoroughly why it is as it is, and operates as it does, and obtains the results that it does, and what influences each particular element in it has on all these factors. Sixth, doing the same with a second farm in this class and comparing every fact and relationship concerning it with the parallel facts and relationships for the first farm; and similarly for other farms in the class. Seventh, proceed similarly with the other classes. Eighth, integrate the results for the several classes; and ninth, generalize the results for the area.

The closest early approach to the use of the case method in farm management research was in R. L. Mighell's study reported in part in Massachusetts Bulletin 275, *Planning the Farm Business on Three Dairy-Fruit Farms in Massachusetts* (1931). Mr. Mighell does not state in this report that the three farms described and analyzed were selected from twelve for which data were obtained in detail, and that the work done on the other nine not only assisted in selecting these three as best representing three sets of conditions found in the area, but also helped to explain what was found on these three; and was also being used constantly as a basis for interpreting conditions found on still other farms in the territory.

A method of detailed analysis freely used in case studies of farm management is to work out budgets for enough possible alternative organizations to discover what circumstances have caused the farm to be organized as it is, and which of these circumstances can be changed,

which must be accepted as they are, and finally, what is the best program for the farm. The results can be combined into statistical tables if enough farms are included to make the results statistically significant. Mighell concluded, in his use of this method in developing supply curves for dairy farms in Vermont, that fifty farms would be a sufficient sample for his purposes.[9] Black and Wilcox concluded that sixty farms would provide statistically valid results in a study of test-demonstration farms in the Eastern Valleys of Tennessee. In this latter study, the purpose was to discover how a carefully chosen sample of test-demonstration farms needed to be reorganized in order to take full advantage of phosphate fertilizer being made available to them by the T V A and to compare with these reorganizations the changes that actually had been made.[10]

The case method was also used in the group of studies conducted in the Southeast by the Bureau of Agricultural Economics in collaboration with North Carolina, Georgia, Alabama, Tennessee, Kentucky, Mississippi, of which use was made in Chapter XIII; and has been used in similar studies in other regions in recent years.

SAMPLE SURVEYS Farm organization can also be studied by noting the changes taking place currently and discovering what factors are associated with these. The published reports of the Illinois and Iowa farm account records over 12 and 21 years respectively show how these may serve such an end. A more direct and much more comprehensive way is to sample the farms of a state or an area, — perhaps using A A A records for this and applying mathematically correct sampling procedures — and collect the specific data needed from these farms each year. A few thousand farms will be enough in most states. The Iowa and North Carolina Experiment Stations and the Bureau of the Census have been studying and testing these types of procedures in recent years.[11]

CHOICE OF METHOD Four observations in conclusion: (1) no one method of analysis is best for all purposes; (2) nearly all the efforts in the past have well repaid their costs; (3) some other method than the one now in use would in a majority of cases yield a larger return upon

[9] R. H. Allen, Erling Hole, R. L. Mighell, *Supply Responses in Milk Production in the Cabot-Marshfield Area Vermont*, U.S.D.A. Tech. Bull. 709, 1940.

[10] *Progress and Possibilities for Further Progress in 50 Units Test-Demonstration Farms in the Valley of Tennessee, June 1942*, Tennessee College of Agriculture, University of Tennessee, and the U. S. Department of Agriculture cooperating.

[11] W. D. Goodsell, R. J. Jessen, and W. W. Wilcox, "Procedures Which Increase the Usefulness of Farm Management Research," *Journal of Farm Economics*, November, 1940.

the effort put into it; (4) much more headway has been made in developing methods of collecting data than in *discovering what data are most worth collecting*, and *how to analyze them to obtain significant and useful results.*

FURTHER READING

No record-keeping forms have been included in this chapter. They are provided by most of the states; or are found in John A. Hopkins, *Farm Records*, published by the Iowa Collegiate Press.

For more detailed discussion of methodology, see *Research Method and Procedure in Agricultural Economics*, and *Research in Farm Management*, both published by the Social Science Research Council, New York City, also both now out of print, but available in most libraries.

Also see:

* Samuel W. Mendum, *Useful Records for Family Farms*, U.S.D.A., Farmers' Bull. 1962, 1944.
* *Farm Bookkeeping and the Federal Income Tax*, U.S.D.A. Misc. Pub. 554, 1944.
* Paul S. Williamson, *Costs and Returns from Farm Enterprises*, Cornell Bull. 756, 1941.

EXERCISES

1. Make up a monthly record of the cash receipts and expenditures for a hypothetical but typical farm in your community.
2. Make an opening and closing inventory for the same farm, and determine its change in Net Worth.
3. Draw up the proper forms and farm map for a typical farm in your area and keep the field records for it for one season.
4. Work out a table of feed utilization, such as given in Chapters XI and XII, for your home farm. Compute the T D N's consumed by each class of livestock, using Morrison's tables, and check the results against livestock maintenance, production, and growth requirements.
5. Check, in the same way as indicated for Exercise 4, the records for one farm in a herd-improvement association.
6. What man-labor and tractor-labor records would you need for budgeting analysis on your home farm?
7. Compute the labor income and usual coefficients, like crop acres per man, for one farm in your area. Compare the results with those obtained by other students on other farms in the area.
8. Write numbers for all the A A A farms in your township (or town) on slips of paper and shake them thoroughly in a hat. Then select 50 at random and place them on a map of your township. Next, classify the A A A farms in your township into classes according to system of farming and size (using whatever measure seems best) and select 50 farms that best represent these classes that are distributed among them according to the size of the classes. Put these on the same map as the 50 taken at random and compare results. What purposes would each sample serve best?

CHAPTER XXIV

The Management of Farm Equipment

WITH THE PRINCIPLES AND METHODS OF ANALYSIS DEVELOPED IN PART TWO and PART THREE, we can now proceed to consider with some degree of thoroughness a considerable list of farm management problems that have been only suggested in the preceding chapters. Some of these problems are best grouped according to the different major factors of production — machinery and other equipment, labor, and land; others according to phases of farm management, including buying and selling, financing, and planning; and others, like the valuation of farm property, are special problems connected with the foregoing.

CAPITAL GOODS IN AGRICULTURE

This particular chapter deals with the management problems of what are known to economists as capital goods, that is, products of past production used in further production. From the standpoint of their role and behavior in production, the capital goods used in agriculture can be grouped under the main heads listed in Table 60. The values given in this table are not all mutually exclusive. Thus, part of the crops are reported also under feed. The value reported for land includes the total value of land, not just the value of the land improvements and fixtures, which are all that can be called capital goods.[1] The census data do not make possible any further breakdown of these items.

Production with capital goods developed, we learned in our elementary courses in economics, because a given amount of labor produces more if part of it is used to make tools and equipment for the rest to work with. Since 1850, the amount of machinery on a farm in the United States has quadrupled. Buildings per farm have also quadrupled, and numbers of productive livestock have about doubled. How much has this increase in the capital goods enlarged the output of farm labor?

[1] One has only to compare tracts of land to which nature has contributed much in the way of natural fertility, good soil structure and texture, and favorable rainfall and climate, with land not so favored, to discover that nature is still contributing a very large part of the present value of much of our land.

TABLE 60. VALUE OF LAND AND CAPITAL GOODS USED IN AGRICULTURAL PRODUCTION, UNITED STATES, 1940

	(Millions)	
Land — including improvements and fixtures	$23,236	
Buildings	10,405	
Dwellings		$5,723
Other		4,682
Farm equipment	3,060	
Motorized [a]		1,202
Other		1,858
Horses and mules	1,202	
Productive and breeding stock	1,767	
Milk cows		1,351
Chickens on hand [b]		189
Sheep and goats [b]		227
Breeding stock [c]	544	
Beef cows		435
Sows and gilts		109
Growing stock	2,149	
Calves, heifers, steers		813
Hogs sold or butchered [d]		804
Chickens raised [d]		359
Sheep sold or butchered [d]		173
Growing crops (value at harvest) [e]	5,775	
Supplies during the year	3,818	
Feed [f]		3,300
Commercial fertilizer		218
Other supplies		300

[a] Tractors, trucks, and 40 per cent of the value of automobiles.
[b] Includes some growing stock.
[c] Incomplete, because breeding and production are combined in large measure; also because of omission of sires.
[d] The average value of these on hand at any time was much less than this figure.
[e] The value of the mature crops is, of course, more than the investment in growing crops at any time except just at harvest time for each. The value of pasture was not included because no data are available.
[f] Purchased feed, plus an estimate of value of home-produced feed fed to livestock. This amount of feed is not at hand at any one time.

The best evidence on this subject is that over the stretch of years from 1869 to 1937, output per farm worker increased at the rate of 2.1 per cent a year. This means doubling about every forty years. This compares more favorably with industry than is commonly supposed. The parallel figure for manufacturing is 3.9 per cent per year.[2] Great advances

[2] John D. Black, *Parity, Parity, Parity.* Harvard Committee on Research in the Social Sciences, 1941, pp. 79–80.

in some large-scale industrial plants have made us overlook the large numbers of smaller plants that have made little progress. The statistical principle of the inertia of large numbers appears in the case of industry if all sizes of plants are included, even as it does in agriculture.

Table 61 compares the gains in output per worker in manufacturing and in agriculture by decades since 1900. The first column for agriculture includes the women and children who help with the farm work, mostly on a part-time basis. The decline in numbers of these, especially since 1920, makes the increase in output per worker appear altogether too high. On the other hand, computing output per number of adult males only, as in the last column, makes the increase appear too small. Probably a figure of around 170 would be about right for 1940. This would mean a gain of 17 to 18 per decade since 1900 as compared with 21 for the whole period since 1869. The increase was small from 1900 to 1920. All of the gain in the thirties occurred in the last three years of the decade. The comparable gains in manufacturing in 1900–1940 were 27 per decade as compared with 39 over the whole period since 1869. The slowing up in the 1900–1920 years is apparent in manufacturing also. In the 1920–1930 decade, manufacturing gained 50, and agriculture probably around 25.

TABLE 61. OUTPUT PER WORKER IN ALL MANUFACTURING AND ALL AGRICULTURE, 1900 TO 1940 (1900 = 100)

		Agriculture	
Years	*Manufacturing*	*All agricultural workers*	*Males 20 years old and over*
1900	100	100	100
1910	112	109	103
1920	131	120	112
1930	181	151	132
1940	210	190	154

Source: The table is based on analyses by the National Bureau of Economic Research, published in: Solomon Fabricant, *The Output of Manufacturing Activities, 1899–1937*. Solomon Fabricant, *Employment in Manufacturing Activities, 1899–1929* (p. 331 especially). Harold Barger and Hans H. Landberg, *American Agriculture, 1899–1939: A Study of Output, Employment and Productivity* (pp. 251–253 especially). New York. National Bureau of Economic Research.

Such comparisons ought not, however, to be limited to industry and agriculture. Two thirds of the peacetime nonagricultural labor force is not employed in industry, but in trade, transportation, construction, mining, lumbering, domestic and professional service, and the public

service. There is no way of reducing the output of many of these activities to a physical-volume basis. But as nearly as it can be done, it would appear that the increase in output per worker was only 1.1 per cent per year for all nonagricultural labor. This means that in some lines of activity the gain must have been very slight, perhaps only 1 or 2 per cent in ten years. Most of us are aware that effort in many merchandising lines has more largely gone into competitive selling than into increasing the output of services.

That not all lines of agricultural production have benefited equally from the adoption of laborsaving equipment is obvious to all. Table 62 presents the best available data on this subject for recent years.

TABLE 62. MAN HOURS OF LABOR USED IN PRODUCING 8 FARM PRODUCTS IN THE UNITED STATES IN 1909–1913 AND IN 1934–1936

		1909–1913	*1934–1936*[a]	*Percentage change*
Wheat	per acre	12.7	6.1	− 51
	per bushel	.89	.41	− 54
Corn	per acre	28.7	22.5	− 22
	per bushel	1.09	.90	− 17
Potatoes	per acre	86	76	− 12
	per bushel	.79	.66	− 16
Oats	per acre	12.5	7.9	− 37
	per bushel	.42	.27	− 36
Cotton	per acre	105	88	− 16
	per bale	271	218	− 20
Sugar beets	per acre	113	94	− 17
	per ton	11.2	8.7	− 22
Dairy	per cow	135	140	+ 4
	per 1,000 lbs. of milk	35.5	33.0	− 7
Poultry	per 1,000 eggs	30.6	26.0	− 15

Source: These data were assembled in a study financed by the Works Project Administration, conducted under the general direction of Professor John A. Hopkins of Iowa State College. The results were published in a series of reports bearing such titles as· *Changes in Technology and Labor Requirements in Crop Production: Cotton;* and *Changes in Farm Power and Equipment: Mechanical Cotton Pickers.*

[a] The period varies from this slightly for some of the products.

There are no greater differences between the agriculture of the different regions in the United States than in the extent of their use of machinery and of other capital goods. The average farm in the Midwest had

four times as much machinery and building in 1940 as did the average cotton farm. Large numbers of one-mule cotton farms have little more than $100 in tools and machinery. The tools on an average farm in China could have been bought for $20 of United States money before the war.

Much of the history of modern agriculture can be written in terms of its machines. What the grain binder did to grain growing in this country from 1840 on in the last century, the combine is doing in this century. What the cotton gin did to cotton growing in the South in the early decades of the last century, the cotton picking and stripping machines, together with mechanized tillage and chopping, may almost do all over again in the next few decades. In 1910, the power on the farms of the United States was supplied by 19,972,000 horses and 4,239,000 mules; in 1943, by 9,678,000 horses, 3,712,000 mules, and 1,906,000 tractors. In the same period, the number of motor trucks was increased to over a million, and farm automobiles to four million. By 1942, almost two and a half million farms were electrified. This shift to motor and electrical power has greatly changed the nature of the farm work. Mechanical skills are needed to replace horse husbandry. Much more of the work can be done by the operator and his family.

The machine equipment of a typical Midwestern farm large enough to use ordinary modern machinery is shown in Table 63. This farm has 100 acres in crops and is using its second tractor. It will be noted that some machinery bought as early as 1912 is still performing useful service.

THE ECONOMICS OF MACHINE USE

Let us now proceed to analyze the economics of machine use. This analysis will serve in large part for that of other capital goods. The inputs used in machine operations can be put into two groups: the first, those which are connected with the machine itself, like depreciation, interest, fuel and oil and supplies; the second, those which use or work with the machine, like labor and power. How these combine to determine average costs with increasing rates of use is shown in Table 64 for a one-row corn picker, and in Chart 73 for both one-row and two-row pickers. Part of the depreciation is considered as fixed; this is the loss in value that would take place if the picker were idle or used very little each year. The one-row picker cost $548 new. It is of the mounted pull type. The two-row picker cost $838. Picking time for the one-row picker was estimated at 1.2 hours per acre; for the two-row, half of this. A two-man crew operates the one-row picker, one man operating the

picker itself and a second with a team of horses hauling the corn to the crib and unloading it with an elevator. The two-row picker needs a three-man crew, one operating the picker, one hauling the corn to the crib with a tractor, and a third unloading the corn with an elevator. Man labor was figured as if all hired at 40 cents an hour, and horse labor at 15 cents an hour. These estimates are not to be taken as actual costs, because several of the cost-rates were assumed. They serve, however, to show the relationships of fixed, variable, and associated factor costs in machine use.[3]

TABLE 63. MACHINE INVENTORY OF A REPRESENTATIVE 180-ACRE MIDWESTERN DAIRY FARM IN 1944

Machine	*Size*	*Year new*	*Cost new*	*Estimated years of life*	*Present value*
Tractor	2-plow	1942	$710	12	$650
Silo filler	36″	1936	395	20	275
Thresher	28″	1917	1,700	30	285
Tractor plow	2-16″	1941	160	20	120
Tandem disc	8′	1937	110	20	75
Tractor cultivator	2-row	1942	112	15	105
Corrugated roller	7′	1920	102	25	10
Spring-tooth harrow	9′	1930	40	25	20
Horse-drawn corn planter	2-row	1912	75	33	5
Grain drill with fertilizer attachment	7′	1939	182	20	145
Wagon		1939	80	25	70
Sled		1920	—	—	10
Manure spreader		1932	112	15	35
Horse-drawn grain binder	6′	1914	120	30	5
Horse-drawn corn binder	1-row	1930	195	20	80
Horse-drawn mower	5′	1920	75	25	10
Side-delivery rake		1925	95	20	15
Hay loader		1940	165	20	140
Milking machine		1925	200	30	20
Feed grinder	8′	1918	40	25	5
Rebuilt car for truck	¾ ton				100
Automobile		1935	800	10	240
Deep-well electric pump		1939	150	15	110
Cream separator		1925	120	25	40
Milk cans					40
Harness					25
Poultry equipment					25
Hog feeders					30
Miscellaneous tools					80
Total inventory value					$2,770

[3] The estimates and assumptions follow closely those of corn-picker studies made in Iowa, Illinois, and Indiana.

TABLE 64. COSTS OF USING A ONE-ROW CORN PICKER ON VARYING ACREAGES OF CORN YIELDING 50 BUSHELS PER ACRE

Costs	*Acres of corn picked*						
	60	*100*	*140*	*180*	*220*	*260*	*300*
Machine inputs							
Fixed							
Depreciation	$34.50	$34.50	$34.50	$34.50	$34.50	$34.50	$34.50
Interest	13.50	13.50	13.50	13.50	13.50	13.50	13.50
Taxes and insurance	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Housing	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Total	57.00	57.00	57.00	57.00	57.00	57.00	57.00
Per acre	.95	.57	.41	.32	.26	.22	.19
Variable							
Depreciation	12.00	20.00	28 00	36.00	44.00	52.00	60.00
Repairs	7.80	13.00	18.20	23.40	28.60	33.80	39.00
Maintenance	3.00	5.00	7.00	9.00	11.00	13.00	15.00
Total	22.80	38.00	53.20	68.40	83.60	98.80	114.00
Per acre	.38	.38	.38	.38	.38	.38	.38
Associated factors							
Labor	57.60	96.00	134.40	172.80	211.20	249.60	288.00
Power (tractor)	36.00	60.00	84.00	108 00	132.00	156.00	180.00
Power (horses)	21.60	36.00	50.40	64.80	79.20	93.60	108.00
Total	115.20	192.00	268.80	345.60	422.40	499.20	576.00
Per acre	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Combined costs							
Total	195.00	287.00	379.00	471.00	563.00	655.00	747.00
Per acre	3.25	2.87	2.71	2.62	2.56	2.52	2.49
Per bushel	.065	.057	.054	.052	.051	.050	.050

MACHINE INPUTS Let us now consider separately the elements in machine cost. The largest of these usually is depreciation. The variable part of depreciation in Table 64 is figured as the same amount per acre over the whole life of the machine. This is what is commonly called the *straight-line* method. Often it is applied as a uniform amount per year, obtained by dividing the first cost of the machine by its estimated life. The straight-line method may not be very accurate. A machine may not be equally productive each season. The first year it may require a good deal of adjusting and thus return a somewhat lower output per unit of labor; or because it is stiff, return a reduced output per unit of power input. Later on, it may have to be stopped for repairs occasionally, wasting still more labor. Hence, charging at the same rate each year may make machine costs too high in the later years when the machine is about worn out, and too low in earlier years.

Renewals represent a replacement of parts which wear out sooner than the machines as wholes. The best method of handling these is to distribute the total cost of all renewals over the whole life of the machine. This requires estimating the total renewals in advance at the time the machine first goes into use. The same analysis applies to *repairs*, which are essentially no different from renewals. Included with the cost of repairs and renewals is the labor involved in making them, which is frequently the most important part of them.

The fixed part of the depreciation of a machine is that which takes place whether it is in use or idle. Machines which are exposed to the weather a good deal, like farm machinery, have high fixed depreciation. That special form of depreciation which is called *obsolescence* is also a fixed input. The charge for fixed depreciation in Table 64 is the same at all levels of use.

The investment in a machine is different at different stages of depreciation. At any time after the start, some part of the machine has been used up, and has gone into the product, which product has been sold, so that that part of the investment has been recovered. *Interest* charges are sometimes figured by applying an interest rate to the remaining investment in a machine. The method used in Table 64 is to apply it to the average investment during the whole period, that is, half of the purchase price. A farmer debating the question of whether or not to buy the machine should reckon his interest on the basis of his average interest over the period.

Insurance and *taxes* should be handled upon the same basis as interest. In deciding whether or not to use a machine, a manufacturer figures on the basis of the average property taxes and insurance he will have to pay over the whole period of its use rather than upon what he has to pay any one year. Property taxes are supposed to be levied upon the basis of actual values of properties at the time of assessment. This means more taxes upon a new machine than upon an old one.[4]

The supplies used vary with the machines, particularly with whether they are machines which generate power, like tractors, or which must have power supplied to them, like corn pickers, mowers, and grain separators, or like tractor combines, which provide their own power. In any case, their inputs vary with the amount of work done. The same is true of the considerable amount of labor involved simply in keeping machines in running order, in such work as oiling, cleaning, sharpening, adjusting, etc. Such labor is properly classified as machine input under

[4] Special situations sometimes arise when the unexhausted value in the machine, or the trade-in value, is the better basis for figuring interest and taxes.

the head of *maintenance* labor. It is in addition to the labor used in making repairs and renewals, which was included with this item above.

SIZE OF MACHINE We are now in shape to return to the question raised earlier of size of machine. It is obvious enough that if a machine is too large for the amount of work to be done on a particular farm, the fixed inputs will be so large that the machine will be used to the left of its point of least-cost combination. Even more important, the machine may require so large a crew that extra labor will need to be hired especially to operate it; or an extra-large power unit may be needed. If the machine is too small, on the other hand, it will not get the work done in season, or will not make good use of the regular farm labor force and power equipment. Also, depreciation, repairs, and maintenance become excessive when a machine is overworked.

How these different factors fit together is apparent in Table 64 and Chart 73. The fixed costs of the two-row picker are $85 a year compared with $57 for the one-row picker. The variable machine costs of the two-row pickers are 23 cents per acre of corn compared with 38 cents for the one-row picker. The two-row picker needs to be in use only half as much of the time as the one-row picker to harvest the same acreage. So far as machine costs are concerned, a farmer with 60 acres of corn to pick each year could save $19 a year in buying a one-row picker; with 100 acres to pick, he could save $13; with 220 acres he would lose $5. The associated labor and power costs at the assumed rates are only $1.32 per acre with the two-row picker, compared with $1.92 for the one-row picker. When these are added, however, the chart shows that the total costs are higher using a one-row picker even with only 60 acres of corn to pick, and that the extra cost increases steadily with larger acreage. The sales of one-row pickers, however, are increasing faster than those of two-row pickers. Does this mean that farmers are using poor judgment in choosing the size of machines? Probably not.

If the regular labor force of the farm is able to handle the corn harvest in season with a one-row picker and has time enough for other fall work, and a team of horses would otherwise be idle, the actual man-labor and horse-labor costs may be small. Most farms growing enough corn to use a corn picker were organized to pick the corn by hand over several weeks. If a one-row picker will do the job with the same labor force and horses in a third or a half less time, what more is needed? The additional costs of the one-row picker over hand-picking would be mostly machine costs and fuel costs for the tractor. Or, if special labor was hired for corn-picking, the one-row corn picker will save this

and still do the job in season. If a two-row picker were bought, there would be not only the extra fixed costs of $28 a year, but extra help for a three-man crew paid at peak-period wages. The actual extra cost of having a two-row picker might easily be two or three times the extra $28 of machine costs. These extra costs still might be worth while, however, if the time saved was put to good use on the farm; or if the farm family wanted to reduce its fall work load and take life a little easier.

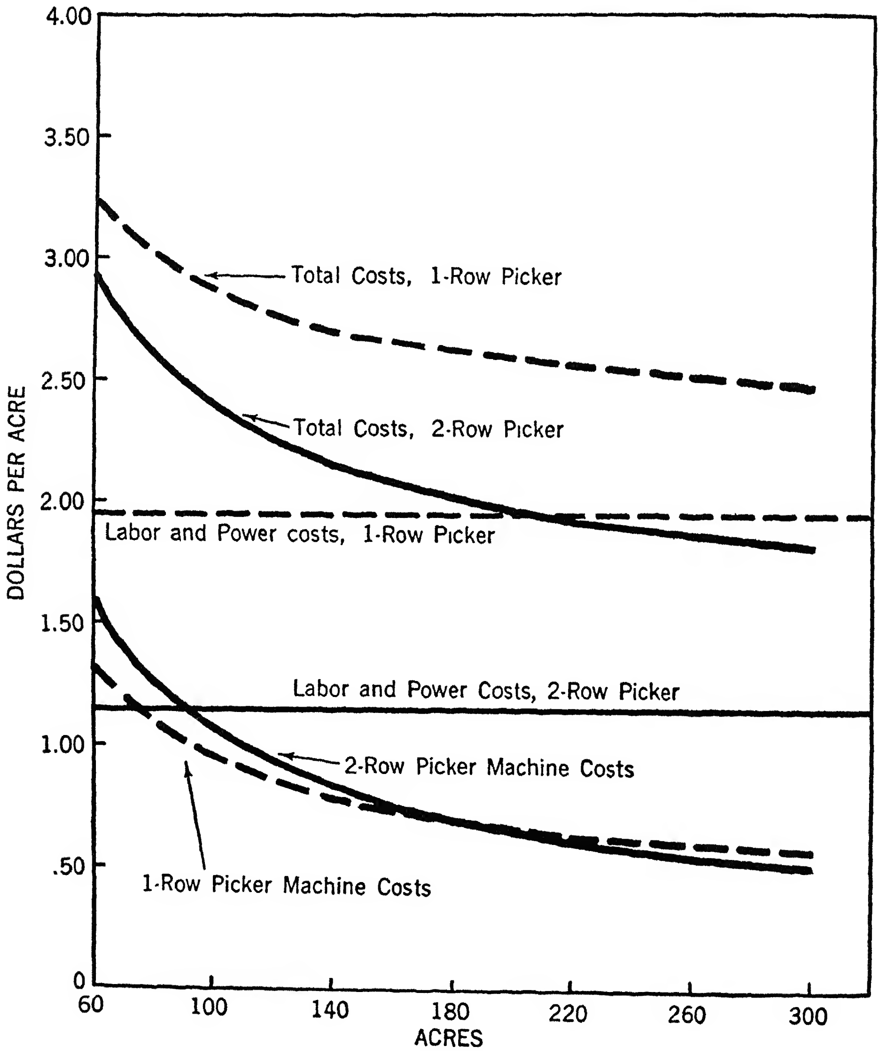

CHART 73. Machine and associated costs of using one-row and two-row corn pickers on increasing acreages of corn.

Here is just another example of how figuring the advantages of alternatives in terms of total costs using assumed cost-rates may lead to wrong conclusions. Only by working out the total receipts and expenses of the whole farm business with a one-row picker and a two-row picker can the full answer to such questions be given. The chances are that one-row pickers will continue to be bought mostly on family-size and two-man farms; two-row pickers on farms somewhat larger, by those farmers who are willing and able to spend something extra to get their corn picked quickly, and by those who plan to do custom picking for their neighbors; and probably the choices made are wise in most cases.

TYPE OF MACHINE The farm manager may have any of the following kinds of choices to make as to type of machine:

A. (1) Between general-purpose and special-purpose tractor units, (2) between wheel and caterpillar tractors, (3) between two-unit and three-unit milking machines, (4) between a stationary silo-filling outfit combined with a corn harvester, and a field chopper with stationary blower, (5) between a field hay chopper and a field hay baler, (6) between a three-man hay baler and a one-man self-tying hay baler.
B. Between a high-quality high-priced machine, a moderate-priced good machine, and a cheap machine not very well made.
C. Between a new and a used machine.

The decision between two different machines or combinations of machines which will do the same job must take into consideration the total costs, including overhead or fixed costs, upkeep, power, and the actual labor costs of doing the job with each machine. Another consideration is the quality of product turned out by the two machines. Harvesting machines may also differ in amount of the crop left in the field. Under average or typical conditions, two machines may be equally economical but one superior to the other under adverse working conditions.

The decision as to what quality of machine to buy involves several types of considerations. First is the relation between price and quality. The general practice of manufacturers and merchants is to lay down the maxim that it pays to buy none but the best, and then for each of them to insist that his make or brand is the best. If this maxim were true wisdom, Mr. Henry Ford would never have made a great success with his Model T automobile. It was a good car for the money, but lacked many qualities — other than aesthetic — that were available in higher-priced cars offered at the time. Although class prices — extra

prices paid by those able and willing to do so — are much less prevalent in producer-goods lines than in consumer-goods lines, they are enough present so that the ordinary farmer must be sure that he is not paying extra for something which he cannot afford. For him, usually the safest machine is *a good machine at a moderate price.*

The principles relating to combinations of capacities and grades of efficiencies work out in an interesting way in the case of machines. There is no reason ordinarily why the makers of machines should not make them of such capacity that they will give a good fit with the other productive agents. And this is what they generally do, except for occasional miscalculations when a new type of machine is first placed on the market. As for efficiencies, each manufacturer is striving constantly to make his machine turn out either more product per unit of input, or a better quality of product. In consequence, there may be very little difference in efficiencies between different makes of machines. Or if there are, those who buy them do not know it, and generally believe that they are buying the most efficient machines. There are circumstances, however, in which a low-priced machine will give all the service required as long as it is needed and at a lower cost. Suppose a farmer has a choice between a machine costing $1,500 which might last 30 years, and one costing $1,000 which will last only 20 years. At the end of 20 years, he would still have $500 invested in his machine, if he bought the better machine, and perhaps by that time it would have become obsolescent. In the meantime, he has had an extra interest cost of $25 a year.

The economy of buying a used rather than a new machine under certain circumstances can be illustrated by the following tabulation for a new grain binder costing $280, and a used one costing $80, if one can assume that the two give equally good performance if kept in condition:

PURCHASE PRICE	INTEREST	DEPRECIATION	REPAIRS AND MAINTENANCE	TOTAL ANNUAL COST
$280	$7.00	$20.00	$14.00	$41.00
80	2.60	10.00	18.00	30.00

A farmer with a full schedule of work for his grain binder cannot afford the delays that may come with breakdowns after the machine is fairly well worn. With repairs and renewals between harvests, however, such a binder may serve an 80-acre farmer five or ten years.

A major decision will often be whether to continue using old equipment or to turn it in toward the purchase of new types of equipment

that operate more cheaply and do better work. In periods when new types of equipment are being developed, the farmers who delay in adopting them may find that their costs have not declined as much as those of other farmers. Probably as many mistakes are made, however, in trying to use new types of equipment before they are sufficiently developed, or on farms not suited to them, as in venturing too little in such matters. The Maine potato grower, whom we discussed in Chapter VII, after a booming year may succumb too readily to the wiles of the implement dealer.

UPKEEP OF THE MACHINE It is possible to spend lavishly on servicing, renewals, and repairs of a machine and get a long period of use from it. Many taxicabs during the war were driven 200,000 miles as a result of regular care, frequent inspections and overhauling or rebuilding of the engines and other parts. This was warranted because new taxicabs were difficult to obtain. At the other extreme are the taxicab companies which before the war followed the practice of giving only ordinary care to their cabs, and turning them in after a year's use. Which practice pays better? Farmers are frequently confronted by the same alternatives. The goal in managing the upkeep of a machine is to expend exactly that amount upon it that combined with depreciation will give the least combined cost of these two items and the other input factors and keep the machine in good working condition. This goal will be realized if the farmer follows a program of regular inspections in which the extent of wear is carefully noted, and renewals are made safely in advance of breakdowns. Such inspections and overhauling can be done by the regular working force at slack periods of the year, and will cost practically nothing other than the materials and parts that must be purchased.

THE MACHINE SHED Studies have shown that it pays to provide housing for machinery in the areas of moderate to extensive rainfall. Many machines can be stored in unused sections of other buildings, but on most farms at least one building is built and used primarily for the shelter of farm machinery. This building should be built as economically as possible and yet provide protection from the weather. It should be located conveniently for the removal and replacement of machines and have at least 12-foot doorways so that wide machines may be stored easily. If the tractor and car are to be housed in the machine shed, it should be located conveniently for the use of these machines and far enough from the hay barns to minimize fire hazard.

BUYING VERSUS HIRING There is no use belaboring the point that a large proportion of the farms in the United States are too small to own the smallest sizes of many machines thus far built. We are likely to see further developments in tillage implements which will fit smaller farms than those now commonly in use, but at the best, there are definite limits in this direction. A 40-acre farm in the Midwest is not likely to have more than 10 acres of small grain; an 80-acre farm, not over 25 acres unless it is in a small-grain section. An ordinary grain binder ought to cut 600 acres in its lifetime. Such a machine will last a 40-acre farmer 30 years if half is allowed for fixed depreciation. An investment of $280 in a grain binder represents a combined interest and depreciation cost of $1.60 per acre for a 40-acre farm, and $.80 per acre for an 80-acre farm. A half-worn binder that cost $80 would still cost $.45 per acre on the 40-acre farm, and $.35 per acre on the 80-acre farm.

A common alternative is custom hiring. This has increased greatly in the last decade. The principal reason for this has been the introduction of a number of types of machines that are too large for small farms, such as the combine, the corn picker, and the hay baler. The all-purpose combine has contributed importantly to this development because it can be used for farm products whose production is scattered and occasional, like clover and grass seed, buckwheat, dry beans, and peas, and soybeans in some areas. Its availability for soybeans has been a very important factor in their increased production. The cotton picker will figure importantly in similar developments in the South.

Custom hiring should be encouraged in every way, first, because it reduces the cost of many operations on small farms and makes small farming more feasible; but more important, because it reduces greatly the burden of work on small farms. The difficulty that several farmers may want custom work done at the same time, and become provoked when they cannot get it, can be met in part if the operator of the custom outfit will work closely with his customers and plan with them in advance. If clover seed is being combined, he can inspect the fields every few days and decide when each field is ready.

The question of rates becomes important. It will be determined by a competitive balancing of what farmers can afford to pay and the cost of such custom work. In normal times, competition between the different operators will tend to keep rates at a reasonable level. Agricultural experiment stations can help in the establishment of reasonable rates by making studies of the machine costs involved.

The farmer who hires his hay baled, or grain combined, has more time for other farm work, and may be able to expand his operations

He may, for example, be able to grow more alfalfa and keep more cows. Such custom work is usually done at peak-load times, and therefore contributes to more nearly uniform year-round employment on the farms.

The out-of-pocket expenses of harvesting 20 acres of oats yielding 40 bushels an acre with a combine in 1945 were around 55 cents per acre in the Midwest; of threshing this grain from the field 32 cents. The combining took only 20 hours of the farmer's time; the threshing, 100 hours.

JOINT OWNERSHIP OF MACHINES The other alternative is for a group of farmers to own a machine jointly. Such joint ownership may become formal cooperation. In any case, it should be arranged on a definite business basis. The cooperative should have a definite membership agreement in which all the financial and other responsibilities are carefully indicated. It is usually most satisfactory to have one man operate the cooperatively owned machine throughout the entire season. Definite provision should be made for determining the order in which the work is to be done on the different farms. Probably it is best to have a committee set up for this purpose. The order in which the work is to be done should be settled so far as possible before the season starts. A small cooperative group is likely to be more successful than a large one because of the difficulty of doing the work for a large number of members at the time needed.

Since 1935, the Farm Security Administration has helped organize several hundred cooperatives owning farm machines. At the start, an alternative plan was sometimes followed of making a contract with a "master borrower" who had charge of the machine and did all the work, and charged each member a rate that was agreed upon in advance or at the beginning of each season. He was responsible for making the collections and paying off the loan. The participating farmers signed a membership agreement, but their responsibilities were somewhat different.

WHETHER OR NOT TO MECHANIZE The most fundamental of all questions relating to the use of machines is whether or not to shift to machine operation. The popular demand is for data that will show the relative cost with and without the machine. It is possible to make such estimates, however, only by assuming average or flat rates per hour or day for man labor, horse labor, and so forth. These can easily be misleading when applied to any particular farm. They cannot safely be used on farms where cost-rates are very different from those used in compiling the

average data. Horse-labor cost-rates depend greatly upon how many horses are kept and how busy they are kept. Man-labor cost-rates are very different on family farms with an abundance of labor and on farms where all the labor is hired. The average cost comparisons usually apply only in case all the man labor is hired.

The safest plan is therefore to reduce all such comparisons to an operating statement or budget. Then, if the time saved by the machine merely means fewer days of work for the regular farm labor force, and the out-of-pocket expenses of the farm are not affected at all, no entrance in the budget is made for it, since the budget shows out-of-pocket expenses only. The farm budget will show how the balance between receipts and expenses is affected, and the farm family will have to decide whether the time and effort saved is worth the extra outlay on the machine. They will be helped in arriving at a judgment on this point, however, if a good estimate is available as to the actual days of labor saved. They should have data of this sort freely available. The family can reason as follows: We can save ourselves fifteen days of labor if we buy this machine. Our farm expenses will be increased by $20. Is this saving of our labor worth $20 to us?

The major saving with tractor power is of course in horse labor. The tractor should reduce the number of horses that must be fed. This releases land to produce more farm products for sale, and makes possible an addition on the receipts side of the budget. On this side of the budget should also be entered any increases in receipts from more timely harvesting of the crop, or better tillage or cultivation. These, of course, have to be estimated, and the individual farmer is not likely to have a good basis for doing this. Experiment stations should undertake to supply farmers with the best data possible on such points. The individual farmer can then adapt them to his special circumstances.

In constructing such budgets, all the variable and fixed inputs listed in the preceding section must be considered from the standpoint of their behavior under the actual conditions of production on the farm where the machine is to be used. Depreciation must be figured in terms of the probable life of the machine as it is proposed to be used. General figures such as supplied by the manufacturers, and averages from farm management surveys, must be adjusted to fit the individual farm.

FARM BUILDINGS

The barn and other outbuildings on a farm should be planned and maintained to minimize operating expenses and to increase the income from the farm. The methods of analysis required in order to reach such

a goal are much the same as for machines. Buildings, like machines, depreciate right from the start, but the depreciation is relatively less because of their longer life. Being exposed to the weather, buildings depreciate whether in use or not. They ordinarily do not depreciate more rapidly with fuller use. The fixed inputs — interest, insurance, and taxes — are a much larger proportion of the total than in the case of machines. Renewals, such as painting and reroofing, are also large in relation to the investment.

Buildings cannot readily be sold at auction and hauled around the country like machines. Once an investment has been made in barns, it ordinarily can be recovered only through continuing to operate the farm. More than this, it has no value after its construction except that which it contributes to the net output of the farm. A farmer may decide for any one of a number of reasons that he wants a $5,000 dairy barn. If after it has been erected, the income of the dairy farm, after deducting other expenses than those connected with the barn, is only $100 more than before, the barn is really worth only $2,500 with the $100 capitalized at 4 per cent.

It was extremely easy in the years between the two world wars to overinvest in buildings. The cost of buildings doubled between 1915 and 1923 and prices of farm products declined. To erect the kind of buildings that a family-size Midwest farm needed in 1940 would have cost $8,000. The annual cost of these buildings for depreciation, interest, taxes, insurance, and renewals would have been $620 at least. A 160-acre farm with these buildings on it would not have rented for more than $1,000. This left only $380 for rent of the land, or $2.40 per acre, which capitalized at 4 per cent equals $60.[5] Perhaps prices of farm products and building costs will be in better line with each other in the next two decades than in the last two.

The farmers most likely to invest too much money in farm buildings are those who have other incomes and are interested in an attractive set of buildings without much regard for the cost. In this case, the outlay on buildings should not be all charged against the farm business.

An important element in keeping down the costs of farm buildings is the design. Barns can be planned so as to use building materials economically or wastefully. The amount of roofing required per unit of barn space is one element in this. Most barns serve the dual purpose of housing of livestock and storing of forage and feed. This combination may be economical or wasteful depending upon the system of farming.

[5] See Ch XXXIII.

Another aspect of design is reducing the amount of labor involved in carrying on the farm work. (This will be discussed in the next chapter.)

Another mistake commonly made is to put excessive amounts of specialized equipment suited to only one purpose into farm buildings. Tobacco production has shifted away from many old producing communities, leaving the tobacco sheds standing idle. The farmer frequently has a choice between tearing down a part-way depreciated barn and building a new one that is well fitted to the new system of farming, or attempting to revamp the old one and make it serve. Many of the poultry houses in the Northeast are rebuilt general-purpose barns that may not be very efficient in the use of labor.

LIVESTOCK

Most of the farm management problems connected with livestock are discussed elsewhere. It is useful at this point, however, to fit livestock into the system of analysis that has been followed in this chapter.

Workstock partakes more nearly of the nature of equipment than of any classification thus far discussed. A horse is much like a power machine in many respects. The input is the feed, and the output is the power exerted or load carried. The efficiency of a horse for feed is the output of work done per unit of feed consumed.

The important difference between workstock and machines is in their manner of depreciating. It is commonly said that work animals appreciate till full-grown and then depreciate. Such a statement involves a certain amount of confusion of thinking. A horse gives up some of its total product, like a machine, from the day it is first put to work. But it is also still increasing in capacity in its early years. A horse passes through four stages; first, a stage of all appreciation and no productivity — the colt stage; second, a stage of net appreciation and of increasing current productivity; third, a stage of net depreciation and increasing current productivity; and fourth, a stage of all depreciation and also decreasing current productivity. The third stage is the "prime-of-life" stage.

Most of the depreciation of workstock is *fixed* depreciation; that is, a horse grows old about as fast under light use as heavy use. Productive livestock appreciates and depreciates in exactly the same way as workstock. A cow appreciates at first, then depreciates although increasing in productivity, then depreciates with decreasing productivity. Net depreciation commences at the point where the loss of latent productivity more than offsets the appreciation from growth. A heifer that becomes

a cow that never returns a net product never has any value so far as milk production is concerned; but it has some value for meat use. The probability that some heifers will never become profitable cows reduces the value of all heifers. Net appreciation and net depreciation of a cow must take account of both milk and meat. Productivity not made use of at the time is largely lost — only a small part of it can be recovered in later increased productivity.

A *meat animal* appreciates while growing and while on feed almost like a good-in-process in a factory. The principal difference is the maintenance input which the animal requires.

DYNAMIC ASPECTS

Any over-all review of current developments in farm equipment would be quickly obsolete. To cite a few of them, however, to show the nature of change in this phase of agriculture, should be illuminating.

Two of the most significant of these changes will be merely named at this point — they are discussed in later chapters. The first of these is the recent progress toward the mechanization of cotton production and harvesting; the other, the development of techniques for more rapid milking. The aspect of the first which is most important is that it takes away the foundation for the labor-intensive low-income type of farming that has dominated one major sector of our agriculture. The second indicates a trend toward bringing into livestock production the type of laborsaving that crop production has been achieving.

The developments in haymaking are interesting because of their diversity. One line of development is the field hay baler that picks up the hay from the windrow. The first machines used three men. The new types are self-tying and require only the one man to drive the tractor. A crew of three to five other men are needed to haul and store the bales if they are stored immediately. Dropping the bales on the ground means an extra loading operation, which may be done by machine, and taking a chance on a rain. These self-tying outfits may bale up to 1,800 bales a day. The bales weigh 40 to 60 pounds. The hay becomes musty if baled with too much moisture in it. The labor time saved with the three-man balers as compared with pitching hay by hand varies from one fourth to one half, according to reports from different states; as compared with hay loaders, from a fifth to a fourth. Even if no time were saved, the balers would come into use widely merely because they save hand pitching. A retarding factor is the high cost of the baler. It has a motor costing perhaps $800 which is used only a few weeks per year.

Competing for place with the field hay balers are the field choppers which pick up the hay from the windrow, chop it, and convey it to a wagon hauled alongside the chopper, from which it is blown into the mow. The hay is not handled by hand at all. Many expect these choppers to win out against the balers except for hay that is to be sold. The hay needs to be more thoroughly cured. More labor-time seems to be saved, and the work is still further lightened. The equipment cost is almost as high as for the baler.

In regions with more rainfall at haying time, the barn or mow driers are making some headway. They consist of air ducts built on the floor of the mow through which air is forced by a fan. The hay is piled in the mow to a depth of 6 to 8 feet when 35 to 45 per cent dry, and after it is cured, another layer is placed on top. This may not give full use of barn space, and the hay is heavy to handle when still partly green. The advantage is that the hay can be handled more quickly between rains, most of the leaves are saved, and most important of all, more of the vitamins are saved. Apparently, however, it is difficult to keep 10 to 15 per cent of the hay from becoming musty.

In the dry climates where hay is stacked out-of-doors, much of the hay is now brought to the stack by tractor-mounted sweeps or buck rakes. These are built 10 to 12 feet wide, with teeth 10 to 12 feet long, and will hold up to 800 pounds of hay. An overshot hay stacker lifts the hay and dumps it upon the stack.

The field choppers used for dry hay are being used to cut green hay to make grass silage as well as corn silage. On a few farms, field-chopped corn silage is now being hauled directly into trench silos, dumped by raising one end of the truck box, and packed by running a tractor over it to whose front some planks have been fastened for spreading the silage.

By 1944, three quarters of the sugar-beet acreage of this country was planted with sheared or split seed. This makes mechanical thinning possible, which reduces the man-hours per acre for this one operation from 25 to 30 hours to around 3 hours per acre. The yields are as high with the sheared seed and with mechanical thinning as with hand thinning. Also, as many as 400 sugar-beet harvesters were used in California for the 1944 crop. By 1945, a large fraction of the sugar cane in Louisiana was harvested more or less mechanically, and flaming was coming into use to control weeds.

In large-scale operations on farms in New Jersey averaging around a hundred acres of potatoes per farm, an investment of $4,500 in machinery and equipment is reducing the field operations to 17 hours of man

labor per acre and 7 hours of tractor use, compared with 37 man-hours and 55 horse-hours in 1912. The equipment consists of general-purpose tractors with tillage, spray, and digging units to match. The growers in New Jersey and elsewhere are experimenting with machines that dig and sack in the field. In Maine where the potatoes are handled in barrels, loaders are being developed which lift the barrels on to the trucks. These cost from $100 to $250.

Bulldozers, brush-cutters, and similar equipment are being used to clear trees from land. This represents an application of use of large heavy-duty power. Such equipment can be adapted for the purpose of removing stones, burying stone fences, filling in gulleys and draws, and removing stumps and brush from the land. Other heavy equipment is being used for building terraces and leveling the land on irrigation projects.

The important developments under way in the use of tractors are as follows:

1. More farmers are able to organize their operations in such a way as to use no horses at all, or one horse or a team for some operations.
2. Tractors are being built in smaller sizes to fit small family-size farms and even part-time farms.
3. Full outfits of tillage and other equipment are being built in sizes and types to go with tractor operation, and the arrangements for shifting from one to the other quickly are being rapidly improved.
4. Farms somewhat above family sizes are increasingly using two tractors — sometimes a special-purpose in combination with a general-purpose tractor, sometimes a smaller in combination with a larger.

The developments in farm buildings are motivated to some extent by laborsaving, but more by new developments in technology. The central hog house, to cite an example, unless rigid sanitation measures are followed, transmits disease and infection from one generation of hogs to another. In recent years, hog farmers have been solving this problem by using movable hog houses and placing them on clean ground each year. To provide extra warmth for early pigs, the movable hog houses can be placed on a clean lot near the barns and electric current can be run out to them for electric pig brooders. Many farmers now have their sows farrow in their otherwise vacant horse stalls or in a temporarily vacant section of a barn.

In similar fashion, in recent years, the use of an open shed for housing the cows, with a warm milking parlor where the cows are brought in for milking, has found favor on an increasing number of farms. More bedding is needed to keep cows clean in an open shed, however, and

bedding is scarce in some areas. The manure is better conserved in the shed housing, and building costs are lower than with the usual dairy barn. Experimental work in progress at the University of Wisconsin indicates little difference in milk production between cows wintered in an open shed and cows kept in a warm dairy barn.

FURTHER READING

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EXERCISES

1. To what extent have machines replaced labor in your community since 1940? What factors condition further development in this direction in the next ten years?
2. Estimate all the costs involved in the use of a major item of machinery used in your state and show how they vary with acreage or output.
3. Work out a budget analysis indicating the advantage of using a new machine (such as a small combine) for a typical farm in your home community.
4. For your home farm or some other farm which you know well (describe briefly), list the important farm machines, give their sizes and approximate hours of use by each during the year.
5. If you were stocking this farm with machinery anew, list the machines you would buy, giving their size, and indicate whether you would buy new or used ones, and why. What would it cost to re-equip this farm with machinery?
6. Calculate the annual cost at present cost of construction of a new modern barn for your home farm.

CHAPTER XXV

The Management of Labor on Farms

THE MANAGEMENT OF LABOR ON FARMS NEEDS TO BE CONSIDERED IN terms of the whole farm labor force, not of hired labor only. Even the labor of the farm operator has to be managed. If the proprietor labor and unpaid family labor on the farms of the United States in 1940 were assigned wages equal to that of hired farm labor, with adjustments for work off the farm of part-time farm workers, and for age and sex, the total wage bill would be $3,200,000,000. The comparable value of the annual use of the land in buildings would be $2,300,000,000; [1] of farm machinery, only $525,000,000. We are therefore dealing in this chapter and the next with easily the largest contributor to the agricultural output of this country.

Moreover, $100 of annual input in the form of labor may take more management than the same amount in the form of land, buildings, or machinery. In fact, we have already affirmed, in Chapter XIX on "The Size of Farms," that management of farms is more nearly proportional to labor than to the other factors of production. Let us now see what this statement means. A farm operator who is considering ways of expanding his business might increase his output a half in any one of the following ways: (1) with his present labor force, farm more land, thus shifting to more extensive production; (2) with his present force, use more machinery and till his land more intensively; (3) with his present force, increase the number of livestock on the farm, making the other adjustments needed to go with this; (4) buy more feed and fertilizer; (5) hire more labor on his present farm, making other adjustments to match. Which of these five changes would call for the largest increase in his time and thought and managerial effort? Common observation is to the effect that the fifth of these would make the largest demands on management; the livestock alternative would probably come second; the machinery, third; the land, fourth; and the fertilizer and feed, fifth.

[1] Net rent + depreciation and upkeep + taxes and insurance.

The choice which any farm operator or manager makes, however, will be determined by his particular abilities. Some have good ability to manage men and some not. Others are more accomplished as managers of land, or of equipment, or of livestock. As pointed out in the chapter on "The Size of Farms," large numbers of farmers in the United States do not have enough ability as managers of men to warrant their undertaking to enlarge their businesses by adding more labor. Even with only one hired laborer, the output per unit of labor falls off so sharply with some farm operators that the farm income is reduced.

TABLE 65. NET RETURNS TO FAMILY LABOR AND MANAGEMENT PER WORKER COMPARED WITH WAGES OF HIRED LABOR, PER MAN-YEAR, ACCORDING TO FARMS CLASSIFIED BY VALUE OF PRODUCT, UNITED STATES. 1939

Value-of-product groups	*Hired labor per farm, man-years* (1)	*Returns per family worker, man-years* (2)	*Wages of hired labor per man-year* (3)	*Ratio of (2) to (3)* (4)
\$250–\$399	.12	\$ 96	\$152	.63
400–599	.16	178	166	1.08
600–749	.21	247	164	1.51
750–999	.28	291	185	1.58
1,000–1,499	.37	354	240	1.47
1,500–1,999	.49	451	292	1.54
2,000–2,499	.60	560	325	1.72
2,500–3,999	.83	772	367	2.09
4,000–5,999	1.39	1,053	424	2.49
6,000–9,999	2.19	1,722	478	3.60
10,000 and over	7.16	6,982	595	11.74

Source: Louis J. Ducoff and a committee of the Bureau of Agricultural Economics, *Wages of Agricultural Labor in the United States*, Tables 31 and 32, U.S.D.A., B A E, 1944.

That many farm operators are able to employ additional labor to advantage, however, is clearly indicated by Table 65, in which the farms of the United States in 1939 are grouped according to value of product used as a measure of size. Column 1 shows how much labor these farms hired, and Column 3 the rate at which they paid for it. It will be noted that the larger the farms, the higher the rate of pay — and that the differences are very wide. Column 2 was obtained by dividing the net incomes of the farms by the amount of family labor

(operator plus unpaid family labor) expressed in full man-years. Returns to entrepreneurship and management are of course included in Column 2, as well as returns to labor, and also returns on capital invested. Beginning around $2,500, a good deal is left for capital, entrepreneurship, and management after paying more and more for hired labor. In the lowest size-group, $250–$399, the small amount of labor hired, no doubt for occasional peak-load work, was paid at a higher rate than the farm family received for its own labor. Peak-load labor also affects the results in the next size-group. From there up to $2,000, the ratios in Column 4 rise very slowly, suggesting that the returns earned in excess of wages were scarcely sufficient to cover returns to capital. Above $2,000, the ratios rise rapidly.

The results in Table 65 are, of course, strongly influenced by regional differences. The low wage-rates and low returns on family labor in the upper part of the table represent mostly Southern cotton and tobacco farms and the small general farms of the border states. In several sections of the country before the war, a farmer had less left for himself from his own work and that of members of his family than he paid his hired labor, after allowing a return on the land and the capital invested.

THE ECONOMY OF LABOR USE ON FARMS

It is apparent from the foregoing that human labor is not all used with equal effectiveness on farms. Yet it is vital for human well-being that all of it be used as effectively as possible. After all, when we are trying to use machines productively, we are mainly trying to economize the human labor that is stored in them. A good part of land, we have learned, is also nothing more than stored-up labor.

To avoid all questions of possible divergence of objectives of employer and employee, let us first assume a farmer employing his own labor and nothing more. Next, as a first step in the analysis, let us assume that this farmer's objective for himself is to turn out the largest possible amount of work day after day and that he has no conflicting objectives. There is a maximum of this kind for each person. The more such a person eats and sleeps, the more foot-pounds of work he can do, up to the limit of his capacity. Tests have shown that all persons are about equally efficient in converting food energy into physical work — the ratios range from 20 to 23 per cent; but they vary greatly in the amount of food that they can convert into work — that is, in capacity. No doubt there is a similar set of input-output and capacity relationships for mental effort, except that other things than food figure in it largely.

OPERATOR LABOR Given a farmer working up to his capacity in the manner described, there still could be an immense range in his output of work, as determined by:

1. His rate of working, and how well he distributes his effort. It is easily possible to work too hard by spells and not get as much done in a day, or in a week, or in some longer period.
2. How much waste motion and effort he saves.
3. How well he keeps himself busy at useful tasks. It is not easy on farms always to have some useful work at hand to do, with the result that farm labor is more or less idle a good deal.
4. Whether he always does the most important things to be done at the time.
5. Most important of all, what other factors of production he associates with himself and in what proportions — what power and machinery, land, fertilizers, feed, etc. There is, as with other factors of production, a combination of these with his effort which gives the least-combined cost for them. His interest is in applying these to himself to the marginal point, to the point where the last units of them just pay for themselves — that is, to his point of highest-profit combination, although what he is getting for his effort as a laborer is better called wages than profit.

The next step in the analysis calls for recognition of appreciation and depreciation in the human agent. A man's rate of work may be so high that he wears himself out too soon. The optimum rate is the one which enables him to turn out the most work in his whole lifetime, and must be adjusted to his changing capacity from youth to old age. A human laborer goes through the same four stages as defined for a work horse in Chapter XXIV.

The appreciation of a human being differs from that of a work horse, however, in one important respect — it is much more subject to determination. By taking time out from work in his youth to go to school and to learn a trade or profession, a boy makes himself much more productive later on. Even well along in life, a farmer may learn things, or even learn how to do things, that add importantly to his output. The human animal may be depreciating physically well before fifty years of age, but more than offsetting this by acquiring new knowledge and skills. It must be recognized, finally, that effort can be wasted in trying to appreciate. In the aggregate, a vast amount of it is so wasted, even in our public school system.

Next, we must recognize that most persons have other motivations in life besides turning out the most work, and these are weighed in in

all determinations of how men use their efforts. Or they may not be weighed in, but instead exert themselves as powerful instinctive or emotional reactions. The amount of work done is likely to be conditioned by the rate of its reward as well as by working conditions.

Lastly, we must again refer to the fact that the usual farm operator is a combination of laborer, manager, and capitalist, and divides his thinking and often his time between these three roles. His economic objective as such is to secure the largest return from a combination of all three.

FAMILY LABOR The economics of family labor-use parallels closely that for operator labor. The differences are that a stronger emphasis is placed on appreciation and that modern young people on farms begin at a relatively early age to react for themselves and have their own sets of objectives and to determine for themselves how they shall use their efforts. Any programing of the work of members of the family must therefore take account of reactions and motivations other than those of the operator himself.

HIRED LABOR When part of the farm working force is hired, two different human economies are brought together. The hired workers weigh against each other a different set of inputs and rewards than the operating farmers in determining how and when and where they work; or they have a different set of emotional drives and reactions. The usual hired worker is interested in wages, in the progress which he is able to make, in security, and in working conditions. When labor is hired on a time-rate basis, obviously the more work that an employer can get out of his labor in a given period, the lower his labor costs per unit of output. Good management successfully forestalls any conflicts arising out of these differing motivations.

In the ordinary sense of the term, *human effort cannot be owned by somebody else*. The laws do not even enforce an agreement to do work. If I hire you to work for me for a month, and you tire of your job and quit in the middle of some fine morning, I cannot make you come back to work. That would be called "enforced servitude," or slavery, or "peonage." Of course, actually the laborer is not as free as this — he frequently needs his job in order to support his family, and may continue working even though he does not like the treatment he receives; or his chances for advancement in his chosen field force him to keep in line and do as is "suggested." But to all is accorded at least some measure of choice. There are always alternatives, although they may not be pleasant to behold. And the employer of labor, no matter how much advantage

he may enjoy from the "nature of things" or economic circumstances, is never able to constrain his employees beyond a certain point, and never certain of their future conduct. One important consequence of this is that most employers do not go very far in training their employees. For no sooner may they have them trained than they may quit and go to work for a competitor.

THE NATURE OF FARM WORK

The management of farm labor is strongly affected by the special characteristics of farm work. This is usually summed up by saying that agriculture does not lend itself so well to specialization by tasks. In this respect, it is in the same class with most services and merchandising operations. In fact, when one thinks of the obstacles in the way of specialization by tasks in agriculture, and how much specialization is responsible for the achievements of industry, one wonders how agriculture has progressed as much as it has.

SPECIALIZATION BY TASKS IN AGRICULTURE Let us consider the special nature of the problem of specialization by tasks in agriculture. The two major aspects of such specialization, we shall see, are *fitting the man to the task*, and *developing a tool or a machine to fit the task.* How do these work out on farms?

1. Agriculture has relatively few repetitive tasks. In a factory, most of the workers do the same thing over and over from morning till night months on end with little variation. On a diversified-crop-and-livestock farm, the chores are repeated each day, including milking, but the field work changes from week to week. Even when the task is the same, a good deal of adaptation to special conditions may be needed. On specialized farms, there may be much more repetitiveness — at such tasks as chopping and picking cotton, thinning and topping beets, picking fruit, and bunching vegetables for the market; but any one of these jobs usually lasts only a few weeks. Driving a team is much the same, it is true, regardless of what it is hitched to. So is driving a tractor. And driving tractors, trucks, and automobiles have much in common. But still a good deal of adaptation is called for. The fork, probably the most commonly used hand tool on farms, is used for pitching a wide range of materials.
2. A corollary of the foregoing is that most workers on farms find themselves doing a wide range of tasks over the year. They may thus never acquire any high skill at any of them.

3. Agriculture has relatively few large operations that can be broken down into small tasks, as can the assembling of an automobile, or the canning of peas, for each of which a man may be specially selected, or which he may learn to perform with great quickness and precision.
4. For a majority of farm operations, the machine has to be brought to the work. It must therefore be pulled, and either develop its own power or carry it with it.
5. Line types of operations, in which the material is brought to the worker, are not commonly possible.
6. Many of the machines are used for only a week or two a year. A large investment may be involved for a little work. Even a general-purpose tractor is not used more than a thousand hours a year on the average farm.
7. The wide range of tasks to be performed calls for a large assortment of special tools and machines. Hay, small grain, and corn must each have its special harvesting machines. When early man first worked the soil, planted and harvested, he used much the same tool for all the operations. Later, the rude plow, the hoe, and the blade for cutting were differentiated; then the cultivator, the drag, and the disc. The more that is learned about tillage, the more diversified become the implements used for it.
8. After all, the amount of power required for most farm operations is relatively small compared with that in industrial operations. There are no tremendous pressures to be exerted as in a steel rolling mill, or a flour mill, or an oil-crusher.
9. Neither do most farm operations require the high speeds that machines can develop, nor the high precisions, nor the high temperatures needed for some industrial processes.
10. Some of the industrial operations that use great amounts of power or high speeds, however, were not performed at all until such power became available; they have not, therefore, replaced hand operations, as have most of the power innovations in farming.
11. The generally small scale of operations in agriculture is a contributing factor to several of the foregoing. The operator of a small farm and his family helpers must be jacks-of-all-trades, and often they cannot afford specialized equipment needed or the laborsaving machines.

"SCIENTIFIC MANAGEMENT" IN AGRICULTURE What has come to be known as "scientific management" in industry, or sometimes called the Taylor System instead, after Frederick W. Taylor, a leading early expo-

nent,[2] therefore does not find in the agriculture of the United States a very good medium in which to develop. It has been introduced much more on the larger estates of Germany on which much labor is hired and much of the work is done by gangs or crews; and more recently on the collective farms in Russia. Some interest in it as applied to truck-growing operations was shown in the early 1930's,[3] but it waned when labor became cheap and abundant again in the Big Depression. Recently the term "work simplification" has come to be used as a substitute for "scientific management" in agriculture. It does not connote all that Taylor and his co-workers had in mind, but it has other advantages. In this text, we shall commonly use the term "work simplification." It involves use of machinery and equipment and buildings as well as labor, but we have reserved discussion of it until labor could be brought in too. Taylor's group emphasized five ways of saving human energy and lowering costs that have applications in agriculture. These are:

1. Reducing waste motion and the time lost thereby. Therefore, a major feature of his work was detailed analysis and timing of the movements of the men at work, originally using stop watches for it, later motion pictures.
2. Economizing human energy and reducing fatigue by adjusting the rate of work and periods of rest so that the worker can do the most work with least fatigue in a day or longer period.
3. Designing and adapting the machine and tools to fit the operation exactly. They talked, for example, about designing a shovel for each kind of material that would hold neither too little nor too much. If it was too small, the worker would have too large an overhead of body movements; if too large, it would tire him too rapidly.
4. Designing the working place so that the worker can operate with as little strain or effort as possible.
5. Standardizing the materials and supplies to fit the machine and the operation.

Taylor did not talk much about laborsaving as such from the substitution of machine power for hand or horsepower; but only because he

[2] "Scientific management" is broader than the Taylor System. The scientific management movement antedated Taylor, but did not attract much attention until Taylor's work was brought to public attention in 1910 when it was recommended at hearings before the Interstate Commerce Commission as a method of reducing freight costs. Developments in the next two decades were strongly influenced by Taylor and his associates Carl Barth, Henry Gannt, and Frank Gilbreth. The essence of scientific management is the application of the methods of scientific research.

[3] R. L. Mighell and R. H. Barrett, *Filling the Silo with Less Labor and Effort*, mimeograph, Massachusetts, 1933. Also see *Research in Farm Management*, Project 22 A, Social Science Research Council.

took this for granted. He was trying to make the machine more productive by using the labor that must go with it more effectively.

WORK SIMPLIFICATION

An industry as diverse as agriculture presents a wide range of conditions under which these five procedures can be followed. Let us review some of the actual experience with them.

BURLEY TOBACCO The operations connected with growing and harvesting and preparing burley tobacco for market have each been analyzed separately by the University of Kentucky.[4] Burley tobacco is harvested on the stalk. The plants are strung on round sticks, six plants to a stick, by driving them down over a round spear point fitted over the end of each stick. The other end of the stick is jabbed into the ground at an angle. Sometimes the stalks are split in two before stringing on the sticks. The sticks of tobacco are usually piled, then loaded into flat-bottom wagons, and hung on tier rails in tobacco barns. When cured, the tobacco is taken down from the rails on some damp day, taken off the sticks and placed in "bulks" ready for the stripping. The first stripper removes one grade of leaves and passes the plant on to another. From 50 to 60 leaves are tied together into a "hand" by means of a tie-leaf taken from the hand. These hands are placed on sticks and then put in a press. The presses used for burley tobacco hold 200 pounds or so. These different operations were studied closely on a sample of the best tobacco farms, and as performed by a sample of workers selected because reputed to be efficient, by means of time and motion analysis, including motion pictures usually; and the best methods practiced by any were fitted together into one unified operation. Then sets of detailed instructions were prepared.

The amount of time that may be saved by such simplification with burley tobacco is indicated by the following: Burley tobacco farmers often speak of stripping 100 pounds of tobacco as a good day's work. In every community a few workers, recognized as good strippers, average 150, 200, and even 250 pounds per day. The ten crews studied in detail averaged 134 pounds in an eight-hour day. The lowest averaged only 82 pounds and the highest 220 pounds each, with tobacco yielding around 1,600 pounds per acre.

[4] The information following is from Leaflets 73, 75, 79, 84 and 86, *Easier Ways to Do Farm Work*, University of Kentucky, 1944, by George B. Byers, Earl R. Young, and Ernest J. Nesius.

Similarly, on twenty sample farms, the time taken to pull the 8,500 tobacco plants required to set one acre ranged from 4 to 14 hours. On ten sample farms, the time used in setting tobacco plants ranged from 6 to 17 man-hours per acre.

A major phase of the economizing of time and effort by work simplification involves nothing more than the use of the hands, as illustrated by the following rules for the simple operation of pulling tobacco plants:

1. Pull one plant at a time.
2. First pull the plants nearest and then work out systematically in semicircular zones.
3. Pull by grasping the lower part of the plant with the thumb, first finger, and second finger, keeping the palm of the hand toward the ground.
4. Pass the plants to the holding hand after pulling three or four plants.
5. Keep the holding hand near the pulling hand.
6. Fill the holding hand comfortably full, 25 to 30 plants, before putting plants in container.
7. Keep pulling with the pulling hand while putting the plants in the ccntainer with the other. Keep the eyes on the pulling hand, not on the holding hand.

The operations of cutting the tobacco and spearing it (that is, stringing it on the stick), of piling and loading the tobacco on wagons, of taking it down from the tier rails in the tobacco barn and putting it in the bulks, of stripping the leaves from the stalk, and of pressing it, were worked out in similar detail.

The general object sought in all of these was to move the hands no more than is necessary by handling as many plants or leaves as possible without overdoing the matter. But it is equally important not to move the feet more than necessary. This means cutting two rows of tobacco at a time and following such detailed rules as the following: When the first plant is struck onto the spear, the right foot is brought up beside the stick about twelve inches out from the row. In cutting the second, third, and fourth plants, the left foot is stepped toward the plant for cutting and is swung back toward the stick for striking, etc. A mile and a half of walking a day is saved by placing the stripping room near the center of a 60- by 40-foot tobacco barn, and an equal distance if the tobacco is bulked midway along the outside of the barn rather than at one corner of the barn.

Movements of the eyes are almost as important as those of the hands and feet. In mechanical planting of tobacco, the rule is to keep the eyes on the setting hand, even when reaching for a handful of plants with

the other hand. Looking back and forth causes eye strain and tires the neck muscles and therefore reduces the number of plants set per day. Hence the following instructions: In spearing the stalk, the eyes must be focused on the spear point. Just as the hands let go of the plant, look for the next plant to be cut. Let the eyes lead the hands instead of following them. Keep the eyes on the place where the plant is to be cut until it is cut, then look back to the spear point.

The rate at which the operations are performed may prove to be a matter of great importance. A worker can step up his natural rate for an hour or two by intense concentration, but his attention soon flags and he tires rapidly. It is important to drive plant-setting machines at a rate that makes the best rhythm for ease of movement of the worker. At two miles per hour in the Kentucky trials, fewer plants were missed, and the distance between plants was most nearly uniform.

The important thing in this case about arranging the working place so as to reduce the strain on the body and to bring the hands into the most natural contact with the work to be done, is having the stripping bench at the right height. This can be arranged most simply by making the bench high enough for the tallest worker and then having movable foot-stands for shorter workers.

Similarly, fitting the apparatus to the particular task has always been the important part of scientific management. The labor of pulling tobacco plants is reduced by using a plant bedboard that can be moved by one man from one end of the board. The worker sits in a comfortable position on this board and pulls the plants toward him. Applying this principle may also mean such simple things as using a sack or basket to hold the plants being set, using a gravity flow hose to transfer the water from the water tank on the truck to the water barrel on the plant setter, and having the hose long enough to serve ten or twelve rows. The tools and equipment used in farm work tend to become fixed in habits and to be carried over into new operations to which they are not adapted.

Sometimes whole operations can be omitted to advantage. Thus, loading tobacco onto wagons directly from standing sticks, without piling it first, saves about one half of the four hours per acre required for the piling.

Wherever crews of men are involved, the work of the different men must be fitted together so that they do not need to wait for each other. In loading and hauling tobacco, the length of the haul affects the size of the crew and the size of the loads, but either two or four men per wagon are likely to be more economical than three men.

CELERY HARVESTING IN FLORIDA [5] Celery is Florida's third most important vegetable crop. Around 310 hours of labor per acre are spent on harvesting and packaging a crop of celery. This is about half of the total labor on the crop. Detailed studies of celery harvesting were made on nine farms in 1943–1944. The range in labor inputs on these farms was from 69 to 109 hours per 10,000 stalks. The operations involved are cutting, trimming the roots, stripping, packing in field boxes, cutting off the tops, loading, additional stripping and root trimming in the washhouse, and handling the empty boxes. Each of these operations was studied by the methods described for tobacco.

The methods used in this case vary by areas. The total labor input is lowest in the Belle Glade area where the methods are also the simplest. Here the men work down the rows, and are paid by the row. One man does the cutting with a hand-knife, the stripping, and the piling of the stalks in rows. One packer handles the stalks for two or three strippers. A topper follows the packers and cuts off the top with a saw or machete. This method, however, is not recommended except with small field crews because the men need to be supervised very closely to keep them from spoiling much celery by cutting too far up on the roots so that part of the ribs fall off.

In the Sarasota and Sanford-Oviedo areas, the celery is cut by means of a push-knife. In the Sarasota area, a boy follows the push-knife cutters and tips the celery over all in one direction, and root cutters walk down the rows and cut off the roots squarely without picking up the stalks. Strippers follow the root cutters down the row.

In the Sanford-Oviedo area, the strippers work across the rows in "downs" usually about fifteen feet wide. They trim the roots to a pencil point by means of hand-knives and strip the celery and pile it in rows for the packers. This pencil-pointing takes more time, but the practice has been adhered to in this area for competitive and other reasons.

The methods of economizing hand movements developed in the Sanford-Oviedo area can be briefly indicated by the following set of instructions: Grasp the stalk with the thumb and forefinger pointing toward the ground about four inches above the root, including in the grasp the part of the stalk which is to be kept, leaving the ribs which are to be stripped off free of the grasp. Holding the stalk with the root toward the body, grasp a handful of the ribs to be stripped off. Drop these ribs immediately when they are torn loose. At the last stripping movement, turn the plant the other way so that the root may be trimmed pointing

[5] The information following is based on Florida Bull. 404, *Celery Harvesting Methods in Florida*, by Max E. Brunk, 1944.

away from the body. Use the knife for trimming the roots only when necessary, and make only one stroke of the knife on the small plants and two on the larger stalks. Release the stalks as the reach is made for the next one.

The instructions also provide for rest periods as follows: Stand erect and rest as needed after 35 to 50 stalks (1 down) have been stripped. Do not rest after each individual stalk is stripped — fewer but longer periods of rest are much better.

The need for developing apparatus is illustrated by improvements in the type of field packing boxes that grew out of this study, and in suggestions as to the type of saw to use in the topping.

The study showed that three or four workers is the optimum-size loading crew, but that some of the farms use six or seven, with the result that the labor input on these operations varies from 2.5 to 4.5 hours per 10,000 stalks. The optimum size of total crew is around thirty workers. A rule strongly emphasized in the report on this study is that "In all harvesting methods, workers should be kept from bunching together as much as possible — several individuals working a 'down' together do more visiting and less work."

The suggestions for economy growing out of this study are carried to the point of arranging the fields in sizes so that the crews can work across them full days, and daytime is not wasted in moving from field to field.

PICKING OPERATIONS Work simplification applied to picking operations can be illustrated very simply by tomatoes and apples. A study of tomato picking in Indiana showed that 70 per cent of the picking time was spent moving the hands between the hamper and the tomato vines. Methods were developed which reduced greatly the number of movements, and then tested in the field to determine the rates of outputs which could be expected from their use. A motion picture was made to help teach the improved picking methods.

In the apple-picking studies, the outputs per worker studied ranged from 75 to 375 boxes per day. Such details were considered as number of apples picked by each hand per minute, the proportion of apples picked double and single, and the extent to which the stems were pulled. As a result of the study, larger picker baskets of lighter weight were designed, and also a lighter-weight ladder. The methods developed included working over a tree to reach all the fruit with the least number of ladder moves, equal use of the hands, rhythm in picking, and handling the fruit after picking.

FIELD OPERATIONS Studies of field operations have consisted mainly of testing and developing different types of laborsaving equipment. For example, in Nebraska the labor and other inputs of pick-up hay balers, of stacking with various types of sweep rakes, of overshot stackers, and of field choppers and stationary choppers, have been made. In North Dakota the use of various grain-elevating devices used in the field have been tested, and also arrangements for emptying grain from grain-box trailers. Also trailers have been developed for moving haystacks containing two to three tons from the field to the feed lot at one operation. Studies of potato harvesting in Oregon and New Jersey, although beginning with hand-picking methods, have more recently been pointed in the direction of mechanical handling of potatoes in bulk, or the use of potato-bagging attachments.

MILKING The development of fast methods of milking illustrate how science can contribute to laborsaving. The advantages of quick milking had been urged for many years, but without much effect until W. E. Peterson of the University of Minnesota showed that under normal conditions a cow lets down all her milk within 40 seconds after her udder is properly stimulated.[6] The procedures based on this consist of massaging the udder with a soft towel which has been soaked in water at a temperature of 120 degrees, and attaching warm teat-cups within a minute afterward. As the udder empties, the teat-cups crawl up on the teat and choke off the milk flow. This is corrected by pulling the teat-cups part way down and using the free hand to massage the udder. The rest of the milk can then be drawn off by the machine so that no hand-stripping is needed. The teat-cups are removed promptly when the milk ceases to flow.

The time required for hand-milking can also be reduced if this same stimulus is applied before the milking begins.

These same studies showed clearly that a cow will not let down her milk if she is frightened or angry; also if grain is placed where it can be seen but not reached by a hungry cow. Some cows, however, never let all their milk down, and some can let it down only slowly. These defects may be congenital, but the second is often a habit induced by improper hand-milking. The best procedure is to milk the problem cows last. Those with congenital defects of this sort are not likely to be profitable producers. Cows which show signs of mastitis should always be milked last to prevent spreading the infection to healthy cows.

The milking operation, however, cannot be considered by itself. The

[6] Minnesota Bull. 361, *The Cow's Udder*, 1944.

teat-cup rack, and a rinse-pail carrier. Changes were also made in small tools, such as the grain scoop, silage fork, floor brush, shovel, and hoes.

"*Improvement of work routines.* The main changes in routines were the inauguration of a 4-minute milking machine interval and the development of quick-stripping habits in cows and milker. Many small changes, designed to hold unproductive travel and work to a minimum, were made in methods and in the order of operations and jobs.

"*Improved positioning of equipment and supplies.* Good work routines and positioning of equipment and supplies are closely related. Two work centers were established, one for general chores, and the other for milking. The first is in the northwest corner of the barn. Here the silage chute and the sawdust bin are located, grain and lime are stored, and the grain cart, silage cart, wheelbarrow, and the forks, shovels, and brushes are kept. Most chore jobs with the cattle, other than the milking, start in this area, move either around the barn in the circuit of the stanchion line, or up the center feed alley and back, and end near their starting point. The second work center is at the southwest corner of the barn. Here the milker is assembled before milking, and rinsed and taken down after use, the teat-cup rack and the switch which controls the milker motor are located, and the pulsator, air hose, milking stool, and rinse pails kept when not in use. The milking starts with the first two cows in the nearby row and moves around the barn in a clockwise direction."

OTHER CONSIDERATIONS Scientific management in industry encountered opposition from the workers in its early stages, and has never entirely recovered from this false start. Some of the workers came to think that it was a way of getting more work out of them for the same pay and reducing the total amount of work available for them. If this is to be prevented in agriculture, rates of pay need to be increased so that the workers share in the increased productivity effected. Also, the factors of fatigue, monotony, exposure to accident, and effects on the health of the worker, need to be considered at every turn.

Usually the application of work simplification calls for more supervision than familiar work procedures. This may mean a substitution of management for labor. This extra supervision can cost more than the saving in wages paid to the labor supervised. It may also have the effect of taking away from the worker some of his responsibilities and hence may not be welcomed by him.

Work simplification is commonly thought of as mainly applying to large farms employing gang labor. The foregoing discussion should convince the family-size farmer that it can contribute much to easing his labor burdens also and to increasing the capacity of his labor force.

EXERCISES

1. Make a list of any changes in farming operations in your community in recent years (other than the adoption of laborsaving machinery) which have reduced the labor required in producing crops or caring for livestock.
2. On your home farm, how many hours daily are put in each month in "chores" or other repetitive tasks? Considering carefully the normal routine of work, how far do you estimate the workers travel daily in carrying out these chores? Draw up a list of suggestions for reducing both time and travel required for this work.
3. Thinking over the farmers in your home community, select two whose farms are about the same size and type, but who manage their own labor and that of others on the farm with very different efficiency, and draw up a list of reasons for differences in their use of labor.

CHAPTER XXVI

The Management of Labor on Farms — continued

IT SEEMS BEST FROM THIS POINT ON TO CONSIDER FIRST THE PROBLEMS of management of labor on family-size farms, which by definition have little or no hired labor; then those on middle-size farms, which employ one or a few laborers ordinarily and on which the employer works along with his men; then those of large-scale farms; and finally a group of problems which are common to all farms employing labor.

LABOR ON FAMILY-SIZE FARMS

For the purpose of this analysis, we are here assuming a farm which is large enough to use the labor of the proprietor and the members of his family, whatever their number, who wish to do more or less farm work. It may be larger or smaller than the average family-size farm in the area.

A major complication in adjusting family labor and farms to each other is that the family is not a stationary thing, but usually goes through a cycle. The young farmer starts out with no help from his family whatever, begins to get a little help at simple light odd jobs when the oldest boy is ten to twelve years, and then more as his family grows up, until such time as some of them may leave home to go to school or to take jobs elsewhere. If he has a sizable family, however, this process may stretch out and he may have considerable family help for ten or fifteen years. Obviously, it is impossible to get a farm that will fit the family at all these stages. If the farmer starts with a farm large enough for his anticipated labor supply, he will need to hire labor while his boys are growing up and probably again later after his boys strike out for themselves. He may instead begin with a small farm and exchange it for a larger one later. This is easier to do if he is a renter than if he is an owner-operator. In fact, this is one of the advantages of renting in the

early years of a farmer's life cycle. Or instead, the family may remain on the same farm, but make certain adjustments.

Of course the whole matter of the family's educational program is involved. In many farming communities, half or more of the farm boys and girls now go to high school. The time is not far distant when all farm boys and girls should have education or training beyond the country grade school and suited to their particular capacities. The farming program will need to be fitted to the time available outside of school hours. If the boy is not to be a farmer, the question arises as to the age at which he quits farm work and starts his training or apprenticeship for something else. If the boy is going to be a farmer, the question arises as to whether he can learn more about good farming by working at home or by working on some other farm. There is a definite advantage in his learning what he can from other farmers as well as from his father.

Given a certain family labor supply, the option arises of employing it all at home or of having some of the boys work for other farmers or take jobs outside of agriculture. This involves a comparison of what the boy's net earnings are, and also his savings, working for another farmer, or at some other occupation, with what he can add to the net income of the home farm. The more usual decision is to keep the boy at home even though he could earn more elsewhere, because of a laudable desire to hold the family together as long as possible. It was Robert Louis Stevenson who wrote "The staying at home is the heavenly way; the going out is the way of the world."

The various ways of enlarging a farm business to provide more employment were discussed fully in the chapter on "The Size of Farms."[1] They include buying or renting more land; improving some of the present land; intensifying production on the present acreage, such as by buying concentrates and milking more cows, or raising more corn silage and alfalfa; and adding supplementary enterprises of a labor-intensive type, or expanding some already in the farm business. A study in which the senior author once participated showed that in southern Minnesota the more family labor was available, the larger the relative acreage of corn and other crops requiring considerable labor; also, the more cows that were milked and the larger proportion of them that freshened in the fall. Many farmers under such circumstances contract for small acreages of cucumbers for pickles, cabbage for kraut, sweet corn or beans for canning, or grow some kind of truck crop for the local market, or small acreages of tobacco or sugar beets. These supplementary enter-

[1] See p. 440 ff.

prises, however, may use barnyard manure that is needed on the regular field crops. Those that depend on hand labor are also likely to yield relatively low returns per hour of labor, and to be somewhat "parasitic." Many families would do better to intensify their regular enterprises by growing more feed and keeping more livestock and supplementing their barnyard manure with commercial fertilizer; or to expand their poultry enterprise to include a few hundred layers.

It is wisdom to analyze the various alternatives as to the use of family labor by simple budget analysis. The family will then know more nearly what it is sacrificing in income if it chooses to follow any particular course of action. Such analysis is even helpful if the decision involves keeping the boy at home or letting him work elsewhere.

A common way of solving the problem of utilizing family labor is to keep it doing things by hand or with one horse that could be done with a team or tractor. Seventy years ago, farmers with plenty of family help were binding their grain by hand and insisting that the self-binder shelled out too much grain. Fifty years ago, they were arguing that corn should be planted with a hand planter because it came up better if planted that way and gave them better stands. Forty years ago, they were making similar argument against the use of hay loaders and manure spreaders, and threshing grain out of the shock; and somewhat later, against milking machines; and still later against corn pickers. Families with plenty of labor tend to mechanize more slowly than their neighbors. One result of this is that the boys are driven away from home. They may work on other farms which have tractors and combines, but more likely they will quit farming altogether. A more enlightened policy is to use such labor to expand the farm business, and to shorten the hours of work, to relieve the burdens of the household work, to grow more vegetables and fruit for the use of the family, and to improve the appearance of the dooryards and lawns.

It should be obvious from the foregoing that family farms will not be inclined to undertake work simplification as long as there is a surplus of family labor. They may, however, be ready to adopt it at the time that the boys leave home. Also, farmers with no boys to help with the chores are likely to be especially interested in work simplification.

LABOR ON MIDDLE-SIZE FARMS

The problems discussed under this head are those which arise once a farm becomes large enough to employ one or more farm hands regularly or for the crop season. The nature of these problems varies some-

what with the number of workers, but not fundamentally as long as the farm operator works with his men.

HOW MUCH HELP TO HIRE Just above family size are many farms which must make a choice between a farm hand for the crop season or for a few months. If the farm family wants to keep busy throughout the year and can get help for short periods when the peaks come, it can probably earn the largest return for itself in this way even though it has to pay high wages for these short periods. If the decision instead is to have a hired man for a season, the farm will have extra help all during the crop season, and as a result the proprietor and other members of the family may not have to work so continuously, and the hours may be shorter except at peak periods. But in spite of any adjustments in the enterprises to keep the rest of the labor force more steadily occupied during other months of the year, the farm may not produce enough more income to cover the wage payments.

Hiring year-round help involves the same considerations in more pronounced form. The average wage paid per month for year-round labor tends to be higher than a combination of crop-season and winter labor because year-round labor is commonly of higher quality and is employed on livestock farms where a higher degree of skill is needed. Often on such farms the only way to obtain the quality of help needed is to employ it on a year-round basis. Workers of this type want to be assured of a home throughout the year. Many of these year-round workers, of course, are married and live in a house near-by, variously referred to in different circles as the farm laborer's cottage, or as the "tenant house," or as the wage hand's cabin.

How much help a farmer can advantageously employ in addition to the first man is largely a question of the size of business which he is able to manage and his resources. If the size of the farm is fixed in terms of acreage, the more labor he employs, the more intensively he farms. At some point, the last worker employed approximately earns his wages, plus compensation to the operator for the extra management he requires; and not to be overlooked often, the extra burden on the homemaker for board and lodging.

A season contract requires the hired man to find other work for the winter months. In the old days, when hired men were commonly farmers' sons, many of them returned home and loafed through the winter. Today, they are likely to seek city jobs, which tend to be somewhat more available in the winter than in the summer, and to shift to year-round city work as soon as they can get a steady job.

WHAT WAGES TO PAY Satisfying himself as to what wages he should pay his hired man is often one of the most vexing decisions that a farmer must make. If he is hiring a new hand, the matter may get settled by his offering too little a few times and then raising his bid until he gets his man. But this is usually feasible only if the hiring is for the season and there is plenty of time for bargaining during the winter. Frequently, also, the question arises in the form of the wages for the second and later years. If the man has proved satisfactory, he is likely to want an increase each year. But the farmer may not believe that his farm justifies this.

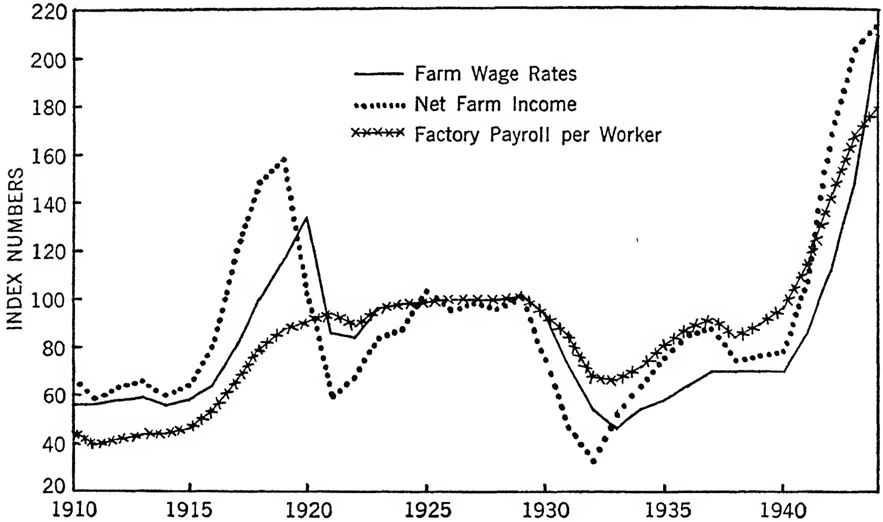

CHART 74. Movements of farm wages compared with those of factory wages and net farm incomes, 1910–1944. (1925–1929 = 100)

Most farmers would like to pay the "prevailing wage," or at least to know what it is, so that they could say how much above or below it they are paying for a particular grade of man. No such wage-rates are generally available.[2] The farm labor market is ordinarily too disorganized, or if a wage-rate does get passed around, rumor-wise, one cannot tell how much it has been biased in various ways in the passage. Public employment offices would render farmers an excellent service if they could report prevailing wages currently.

The farmers are helped in judgments of this kind, particularly in the adjusting of wages from year to year, if they have an understanding of the relationships between wages, farm prices, and other factors that have tended to prevail in the past and what the current trends are in

[2] See the latest survey of *Wages and Wage Rates in Agriculture* issued by the Bureau of Agricultural Economics for the best information currently made available.

the same. In Charts 74, 75, and 76 following, the more important of these relationships are presented. The series are all in terms of 1925–1929 as a base-period, because in this period the relationships between farm prices, farm incomes, farm wages, and industrial wages and farm incomes, were more nearly normal than before or since.

It is apparent in Chart 74 that nonagricultural wages were unduly low in the period from 1910 to 1914 which has commonly been used as a base for various purposes, and farm wages tend to reflect industrial wages in part. Farm wages rose faster than factory wages during the First World War, but not so fast as net farm income. Following the war,

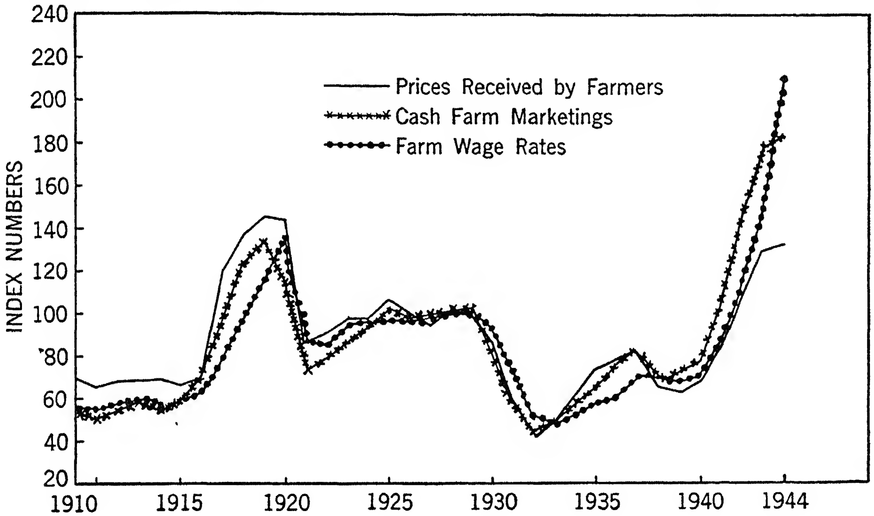

CHART 75. Movements of farm wage-rates compared with those of prices received by farmers and cash farm marketings, 1910–1944. (1925–1929 = 100)

they kept pretty well in line with factory wages until the depression in the 1930's, when they again kept between farm incomes and factory wages. They were very obviously out of their usual relationships from 1935 to 1940, and got into line again only after we were well into the Second World War. It was the inability of farm workers to migrate to the cities as usual in 1935–1940 that kept farm wages so low.

The series in Chart 75 are published monthly. They therefore enable one to make a current comparison of farm wage-rates with prices received by farmers and also with cash farm marketings. This last series reflects changes in volume of sales of farm products as well as in prices. Farm wage-rates rose faster than prices after 1940, and particularly after 1942. They even ran ahead of cash farm marketings at the peak of the war effort.

The third chart in the series shows the relative share of the farm laborer in the earnings from the farm business. It compares the movements in returns to the farm operator and members of his family with the rates paid farm hands after both of them have been reduced to a purchasing-power basis, that is, converted to *real* earnings. It will be noted that the operator and his family fare much the better in boom periods, such as during the two wars, and much the worse during depressions. The same failure of farm wage-rates to keep up with farm returns

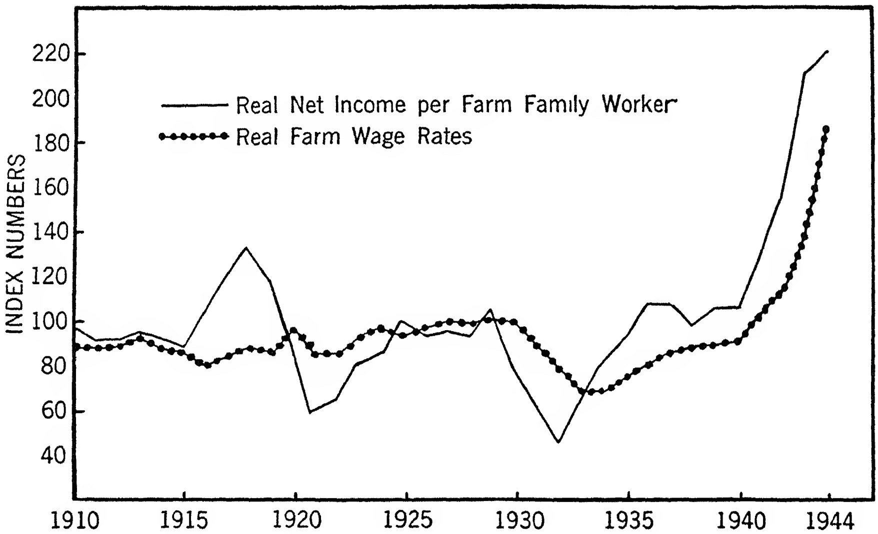

CHART 76. Movements in real farm wage-rates compared with those of real net income per farm family worker.

after 1933 is apparent in this chart as in Chart 74. With this chart as a background, a farmer is in a position to judge how current wages prorate the farm income between him and his hired labor force.

Chart 77 attempts to map the United States into belts or zones within which average wages paid per month with board in October, 1943, came within certain ranges. Thus those in the belt marked 70 range from $70 to $79. Smaller areas within these belts or zones may average a little more or less. In nearly all the Pacific states, Idaho, Montana, and part of Colorado, the rate averaged $100 per month or more; also, in Aroostook County, Maine. In most of the strictly cotton states, it averaged under $30 per month, and under $40 in a broad belt including the border states and the West South Central states except most of Texas. In the northern dairy states, the range was mostly from $50 to $70 per month.

Average wage levels such as given in the four charts and in current reports do not cover the case of differences in wages paid for different grades of workers or on different farms. In the study of wages in Minnesota, the range ran from \$25 to \$85 per month. The majority of the rates, however, were either \$50 or \$60 per month, and the next most common, \$55 and \$65. The modal wage was \$60 in the livestock sections of the state, and \$50 elsewhere. The differences in wages paid are partly a matter of differences in policies of the farm operators. Some

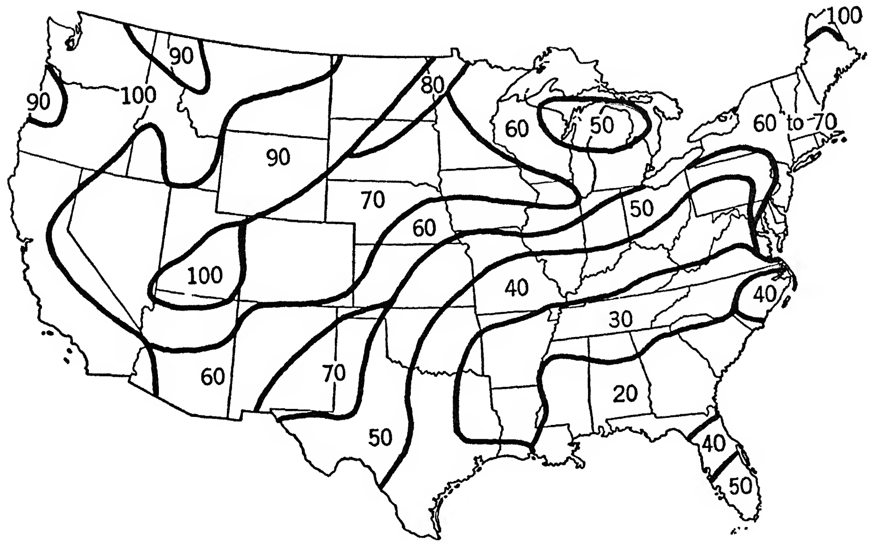

CHART 77. Wage belts and zones, wages by the month with board, October, 1943. (Based on Figure 7 in Ducoff, *Wages of Agricultural Labor in the United States.*)

of them believe in getting the best hired man they can just as they do in getting the best cows. They pay enough to keep such workers satisfied after they get them. Other farmers begrudge the wages they must pay their hired men, and feel that every cent paid them comes out of their incomes. They talk about the hired man getting more out of the farm than they do. These differences in policy mainly reflect differences in the farmer's capacities and efficiencies. The first type of farmer is likely to be able to outbid his neighbors for the more efficient workers. The second type of man really cannot afford to pay top-notch wages; he earns a smaller net income if he pays the going wages for high-class men than if he hires one who is not so good. Differences in wealth, however, are also a factor. Well-to-do farmers are likely to want high-quality help whether they get all of the extra wage back or not. They want to have a good job done even if it may cost them something, and they

want a man whom they can trust to save them from worrying too much about how the work is coming along.

The lower wages paid are for boys and older men. Hiring a low-wage worker may be one of the ways of getting the right amount of labor — the boy or the older man is really a fraction of a man, and the high-wage worker may in effect really represent more capacity than an average worker. The farmer with a unit a little too big for two men may try to meet the situation by employing an unusually good man at high wages, and the farmer with a unit too small to keep two full-grown men busy may try to get along with one cheaper helper. This may not be an altogether happy solution of the problem, but may be the one that will leave him with the largest net income.

LABOR ON LARGE-SCALE FARMS

Most of the discussion of problems on large-scale farms is presented in the section on "General Problems" following because they are problems on all farms hiring labor. For purposes of this discussion, the dividing line between a middle-size and large-scale farm is placed at the point where any of the following changes appear: (1) The farm operator no longer works with his men, (2) a hired manager or foreman may be employed, (3) division of labor appears among the labor force, such as between the field workers and those who work with the livestock, (4) the labor works in gangs. Below this point the farm business is still dominated by the family and still qualifies under George F. Warren's definition of a family farm.[3] Large-scale farms thus defined are only 3 per cent of the six million in the United States, but in 1935 these 3 per cent employed 22 per cent of all the hired laborers working on farms, and produced around 25 per cent of the agricultural output of the country. Hence, they are much more important than mere numbers of farms indicate. This is especially true from the standpoint of farm labor management, for it is upon these farms that some of the problems of such management become most acute.

Table 60 in Chapter XXIV showed that these farms pay higher wages than small and middle-size farms. The farms with values of product of over $10,000 were paying 70 per cent higher annual wages than the middle-size farms when all forms of hiring were reduced to a year-equivalent basis. The comparable percentages for some of the separate regions of the United States were as follows: West North Central, 75 per cent; the South, around 50 per cent; the Pacific states, 65 per cent; the

[3] See p. 49.

Middle Atlantic states, 140 per cent. Several factors contribute to these higher wages on the larger farms. First, most of these farms are highly specialized, and the regular year-round labor is usually skilled and tends to be employed from year to year. Second, some of the employees are assistant managers or the like. Third, many of these specialized farms use peak-load labor which must be paid enough while working to make up for the time lost between jobs. To illustrate one of these reasons the fact may be cited that in 1942 the machine milkers were receiving \$210 a month on Los Angeles dry-lot dairy farms; the hand milkers, \$180; and the general dairy hands, only \$110. In the San Joaquin Valley, the range was from \$105 to \$150. In contrast with these figures was the range from \$50 to \$120 in the Kansas City milkshed, and \$50 to \$70 in the Milwaukee milkshed.

GENERAL PROBLEMS

The remaining problems of labor management are more or less common to all sizes and types of farms. They mostly involve human relations of one kind or another, and some of them relations outside of the farm.

HOURS The average factory work week for the whole country in 1916 was 52 hours. By 1940, it had declined to 38 hours. The average farm work week for the whole country in March, 1940, was 60 hours and in June, 65 hours.[4] In many sections of the country, of course, the proprietor and family labor are not fully employed during the winter months, nor during slack periods between planting and harvesting. But hired labor is usually kept well occupied during most of the days. The hours are shortened somewhat in the winter in such sections, but they are lengthened in the rush periods. Regular farm hands employed throughout the season were working between 3,000 and 3,500 hours per year in most parts of the country before the war, whereas factory workers were employed less than 2,500 even when fully employed, after making due allowance for time spent in traveling to and from work.

Several conditions on farms have contributed to the long working days:

1. The farmers themselves and their families are willing to work long hours in order to make more money and pay off their debts. The owners and their families thus set a pace for the hired men. The hired men have been farmers' sons themselves in many cases and have taken the long hours for granted.

[4] At the peak of the war effort in 1944, factory workers were putting in four hours more per week than in 1940, and farm operators were putting in five more hours per week.

2. Farmers must keep pace with the season and work according to the weather. This makes the load of work uneven from month to month and day to day, and gives the habit of working long hours a fine chance to establish itself.
3. The returns from farming in such a climate as ours are limited by the amount of work that can be done at rush seasons and in good weather. If horses must be fed all winter, they must be worked as long hours as possible in summer. Farm work depends so much on the weather that sometimes an extra hour at night is worth $10 to the farmer.
4. The larger crops which farmers produce by working longer hours bring lower prices. At the low prices thus obtained, the farmer who does not work long hours cannot pay for his farm. Farmers seldom get the things which they have to buy enough cheaper wholly to make up for cheapening their own produce by long hours of labor.
5. The prevailing low level of farm income in the two decades between the two world wars made some of these influences particularly potent. The increased use of machinery and power on farms contributed to larger output rather than to shorter working hours. If farm incomes continue to be on a higher level after this war, and power and machinery are much more freely used, the farm working day can be shortened to advantage by one or two hours except at critical periods.

Working hours on farms do not need to be the same as city hours. Farm work is out-of-doors in the fresh air where long hours are much easier to endure. Also, much of the work offers more variety from hour to hour and day to day than factory work. Moreover, hours on farms can be unusually long for short periods, or even whole months, provided the hours are decreased proportionately at other periods, and particularly if the hired hands get their share of vacations when the work is not so pressing. Farm operators get more time away from the steady grind of farm work than they realize. The hired hands need relaxation too. Vacations for hired men have reduced their turnover importantly where they have been provided.

HOUSING The hired men ask for a home as much as they ask for wages. On many farms they are not allowed to use the living room, and they have no place to stay in the winter save the kitchen or their beds. Sleeping rooms are often unusually cold in winter. Also, much farm work gets one dirty all over, and hence on a farm more than anywhere else a man ought to be able to wash off completely after the day's work is done.

After a week of hard work and long hours in more or less isolation on the farm, the hired men have a craving to see people again. Not only do they want a home, but they want sociability along with it. They found companionship in the farm communities fifty years ago. Today they must seek it in the adjoining towns.

Housing and other facilities for migrant workers present a difficult problem, especially for those with families. Conceivably it could be solved if each family owned a trailer and moved it from job to job as the season advanced. But this would not provide satisfactory living conditions and educational opportunities for a growing family. Those who have studied the problems of migrant labor agree that the families should have a place of more or less permanent abode where the children are regularly enrolled in school and where health and sanitation receive some public supervision. This abode should be near enough to jobs so that the men can travel to and from them daily, or at least weekly, during the periods while the children are in school. The family can travel as a unit from job to job in an automobile during the rest of the year.

This still makes temporary housing necessary on farms employing labor for short harvest and other periods. The expense of this, considering the short period during which it is used, is an important part of labor cost on such farms. The housing therefore tends to be extremely meager. Yet it provides all the housing these workers have during their months of migration.

The attempts to deal with the problem of housing and other facilities for migrant workers by the Farm Security Administration from 1936 on to 1942 are highly worthy of note in this connection. Three types of housing were provided: workers' permanent camps, mobile camps, and labor homes. In California alone, 17 of the first were established, 9 of the second, and 16 of the third. At the end of 1942, nearly a hundred of these were in operation, mainly in the three Pacific Coast states and in Idaho, Florida, and Texas.

The permanent shelters for farm workers ranged in size from 200 to 300 family units, with recreation and community buildings, showers, toilets and laundry, assembly buildings, a study hall, a nursery school, and a shop for auto repairs. They had complete utility, water, and sewerage systems. The first shelters consisted of tents on platforms. Later they were built of simple prefabricated metal sections. In the early years while this program was getting established, no rent was charged. In 1942–1943, the rentals were from 50 cents to $3.25 per week depending upon the size and type of shelter. The mobile camps consist of

platforms and tents and simple cooking, laundry, and sanitation facilities.

Adjoining many of these projects are the labor homes, in groups of from 30 to 84 individual houses. The rentals are around $8.00 per month, including use of the utilities and a garden plot. These homes are for farm workers with year-round work, and are open to residents of the farm worker camps who have established roots in the community. Some of the labor homes are built in multiple-unit apartment style, usually six apartments, and cost approximately $1,600 per apartment in 1940.

The advantages of these facilities to the laborers and to the public are obvious enough. The advantages to the employers are no less important. It is cheaper to provide housing in this way than upon individual farms because it is much more fully utilized. The permanent camps were pretty well occupied as homes for migrant families during the off-season for farm work. Most of the expenses of these facilities should be met by the employers or by the workers. Probably state and local governments should take the lead in building such camps. All these facilities were administered during the war by the Office of Labor of the War Food Administration.

CHILD LABOR The labor of boys and girls can be employed very usefully on many farms, and in such a way as to contribute to the all-round development of their minds and bodies. But it can also be and often is, employed in such a way as to interfere with such development. The work of children in city employments is being controlled in various ways, not only under local ordinances and state laws, but also to some extent under federal legislation.

The Jones Sugar Act of 1937 is the only federal legislation which specifically covers child labor in agriculture. It stipulates that sugar-beet and sugar-cane growers cannot receive benefit payments if they use children under 14 years of age, or work children from 14 to 16 years of age for more than eight hours per day. Even in this case, however, children working for their parents on their own sugar beets are exempted. The proposal for a child labor amendment must be passed by eight more states before it becomes a part of the Constitution.

The responsibility for proper use of boys and girls at farm work is therefore largely still in the hands of the parents. This responsibility is properly met only *if the children are not worked too hard*, or *too much at repetitive tasks*, or *too continuously*, and *if the work can be fitted into their schooling in such a way as not to interrupt it.* The belief that it is good for children to help with the farm work is still well founded.

FARM LABOR AND TENURE Chart 7 in Chapter IV showed that the bulk of the family workers on farms in 1940 were under 20 years of age, with 18 years as the peak, and that the bulk of the hired farm workers were under 25 years of age, with 20 years as the probable peak. Tenants and croppers, on the other hand, were most numerous in the 25- to 45-year groups, with the peak probably around 37 years, and owner-operators most numerous in the 35- to 55-year groups, with the peak probably around 48 years. A large fraction of the farm labor force obviously does not expect to continue in this role throughout life, but looks upon farm labor as preparation for something else, or at least as a stopgap.

The census data indicate something of an increase in the proportion of farm laborers in the older age-groups. This suggests an increase in what may be called the permanent farm laborer group. This group was very small in 1920. It is still relatively small, but has increased perceptibly. This group includes migrant workers from Mexico, the migrants from the Great Plains who were forced out by the drouth or other mishaps, but most important of all, the cotton hands of the South who have never become croppers, or who did not happen to be croppers when the censuses were taken.

Chart 10 in Chapter IV indicates also that more young men now have to start in as laborers than formerly and also that more of them are not taking time to accumulate the resources required in order to become tenants. This is no doubt due in part to the increased resources needed as more machinery and livestock are used in farming. Another reason is that farm hands are less closely incorporated in the family group and spend more of their time and of their income in off-the-farm activities so that savings are considerably reduced. Thus, there is a general piling up of farm laborers around the foot of the agricultural ladder. The effect of this is to discourage young men from trying to climb the ladder and to cause them to look elsewhere for prospects in life. This reduces the supply of the best farm laborers.

EMPLOYER-EMPLOYEE RELATIONS In large-scale industry, few problems are more important than that of relations between labor and management. Capitalistic society is still in the process of evolving some procedure under which labor and management can participate jointly in the conduct of an enterprise in such a way as to call forth the best efforts of both. Agriculture, being small-scale industry, has ordinarily been considered as having no direct concern with such a problem. With all but a fourth of the working force of agriculture consisting of the farmer and his family, and the hired man often a member of a neighboring

family, why should any problem of employer-employee relationship arise? Today, however, more than ten thousand farmers employ ten workers or more, and several hundred employ a hundred or more; and on such farms, employer-employee relations begin to take on the same general character as in capitalistic industry. And agricultural employers have had much less experience in dealing with this problem than have industrial employers.

Moreover, even though such relations may not appear on the surface on a farm in which there is one employer and one or two hired men, they exist in a very real form and are an important element in the success of a million employing farmers. The fundamental problem of employer-employee relations, that of uniting the best efforts of both parties, exists whether one employee is involved or a thousand.

To a limited extent, employer-employee relations are a matter of law. Thus, when one man hires out to another, the employer is boss; that is, he has a right to direct the work which he hires done. The employer is also usually the owner of the property with which the employee works, and both law and custom give to the owner of property almost exclusive control over it. On the other hand, as pointed out earlier, no employee can be made to work for any employer an hour longer than he wants to no matter what may have been provided in a contract. If farmers and hired men are to prosper together, however, they must do more than live up to the letter of the law. Hired men must use with justice their right to quit a job when they will, and farmers similarly their right to discharge a man when they will. "I have seen a hundred men fired," writes one hired man, "and never one of them was given more than time enough to pack up his clothes and git." Hired man and farmer are in duty bound to consider each other's welfare. Farmers should be interested in the hired man's future, and help him save his money and get started for himself as soon as possible. The hired man, on the other hand, should be as willing as the employer to work hard to save a load of hay.

Much of the business of getting along with the hired men concerns the simple matter of giving them instructions as to what to do. As much as possible needs to be left to the judgment of the worker. A good man is sensitive about his mistakes and a wise employer respects his feelings.

On large-scale farms, labor working in gangs has to be directed by foremen, and this introduces a new problem of relations between the foreman and his men. Piece rates and job rates have the great advantage that they take care more or less automatically of the problem of getting a full day's work out of the workers, but they increase the tendency to

slight the work in various ways. Pickers will not pick clean, nor discard inferior fruit, and they may bruise the fruit, or not fill their containers completely. They may not thin and space beets or cotton carefully nor get out all of the weeds.

This problem has to be handled by setting up clear and reasonable specifications as to the requirements of the work and then providing objective and matter-of-fact inspection of the work, and probably adjusting the rate of pay according to the quality of the work. Everything must be done to prevent verbal abuse of the worker for failing to measure up to these standards.

When such piece or job rates are not feasible, reasonable standards can be set up as to what constitutes a good day's work, and these can be made a matter of general information in the area. Experiment stations can be very useful in developing such standards because they can do it in an objective scientific way. Systems of extra pay or bonuses for extra time or extra performance have possibilities that need to be explored in each situation separately.

Conflicts are more likely to arise between employers and gangs of labor than between employers and two or three laborers merely because grievances have a way of feeding upon themselves as numbers multiply. There is always danger that strikes will result, and they are the more likely the more workers on the job. From a third to all the strikes in agriculture in the years from 1932 to 1942 occurred in California. The strike is a poor tool to use in settling grievances in the case of perishable farm products. It is not at all fitted to large-scale agriculture or to food processing. The farmer with a hundred cows to milk is almost equally at the mercy of his employees. The employer is likely to have no alternative at the time of the strike except to meet the demands of the workers. But he can, and often does, retaliate at other times and in other ways. The general public in a matter of this kind is likely to support the position of the employers because the wasting of food is repugnant to all normal people. This tends to leave the workers without the support they need from the public. Because of such a strike, the Wisconsin legislature passed a law establishing a waiting period in the food industries. Other states have passed even more stringent legislation. The tendency is to make such laws general and to penalize all labor organization.

The general public also tends to assume that strikes in agriculture are called by unions, whereas most of them have been spontaneous outbreaks of unorganized groups. The usual prescription of students of labor for dealing with this problem is to organize such workers into responsible unions and to provide for settling wages and other questions

far enough in advance of the harvest period so that there will be no question about lack of labor at critical periods. A number of large employers or groups of employers are following such a program at present, and must find it reasonably satisfactory because they are continuing with it. Others have hesitated to enter into such agreements because the unions with which they would need to contract do not appear to them to be sufficiently responsible and reasonable.

PUBLIC WAGE-FIXING Many believe that public fixing of farm wages will work better than collective bargaining between unions and employers. Certainly if wages on farms employing only one, two, or three laborers are to be established by any other method than individual bargaining, it will need to be by wage boards of one kind or another. Such wage boards have been set up in the United Kingdom, in Australia, and in several other countries. They are commonly on a county or equivalent basis. The English boards determine hours as well as wages, and provide for extra pay for overtime except under special circumstances. These boards do not, however, supplant unions of farm workers in these countries. Representatives of the unions appear before the wage boards at the hearings that are held from time to time.

This country made provision for such boards as a measure of wartime control under three special sets of conditions; and under the Jones Sugar Act, benefit payments to producers of sugar crops are conditioned upon the payment of wage rates determined by the Secretary of Agriculture to be "fair and reasonable." Such rates have been established in all of the sugar-beet and sugar-cane areas.

THE FARM LABOR MARKET [5]

The discussion in this chapter makes very clear that the market in which farm laborers sell their services, and in which farmers obtain the hired labor which they need, is poorly organized. If farmers are able to get labor promptly when they need it, and the kind of labor they need, this is usually possible only because many more workers are looking for jobs than there are jobs for them. Often what appears like a scarcity of labor would be no scarcity if the men and the jobs were brought together. If labor is going to be on hand when it is wanted at the beginning of a crop season, or at cotton-chopping time, or for the

[5] The writers had the assistance of Margot Wakeman Lenhart, now of the California Agricultural Extension Service, in preparing this section. She helped develop the procedures here described while working with the California Public Employment Service. See her article in the *Journal of Farm Economics*, November, 1945.

sugar-beet harvest, it would hardly seem safe to take a chance that it would put in its appearance just at the right time, and in approximately the quantities needed. Yet this is pretty much the way in which this problem was handled until labor became relatively scarce early in the war. Or if measures were taken, they consisted mostly of sending out calls for indefinite numbers of workers so as to be sure to have enough.

An orderly procedure for dealing with this problem is to obtain information in advance as to how many workers of what types are needed, and as to sources and numbers of labor available, and on the basis of this information direct the movements of labor to the areas where it is needed most. The public employment service was beginning to operate in this way in the years just before the war. In California and Oregon, for example, this procedure was well established. Those needing labor for the hop harvest in Oregon, for example, or for the peach harvest in California, were asked to estimate their needs for labor far enough in advance so that the Employment Service could combine them into totals by areas and communities, match against these the local supplies of labor, and calculate how many would need to be brought in from the outside. It then communicated with labor offices in areas where the migrant labor was then employed and undertook to see that enough, but not too much, labor was directed toward Oregon hops and California peaches, and proportioned the labor among the areas.

The employment services therefore functioned in these states much like any organized produce market in causing supplies to be allocated according to their best uses. Their operations had the secondary effect of keeping wages in line with each other in the different lines of production and areas.

The procedures required in the Midwest where the large need is for year-round and crop-season labor are somewhat different from those in the special-crop regions; but those described can nevertheless be adapted to Midwest conditions.

Employers in the past have by no means collaborated fully with the employment services. The better employers have usually managed to get all the labor they have needed operating by themselves. The same migrant workers have tended to return to these employers each year.

Also, early in the war, Congress directed the agricultural extension services to assume the major responsibility for seeing that the farmers in each county obtained the labor needed, and imposed restrictions on the recruiting of labor in other states or even counties.

It should be apparent that collecting over-all national and state-wide data on the demand for labor and on supplies of labor, which was about

all the Department of Agriculture was doing before the war, has very little usefulness. The information on demand and supply must be highly local and specific.

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EXERCISES

1. Make a critical evaluation of the labor supply on five farms with which you are familiar. How many of them have an excessive labor supply? On how many farms is the labor supply inadequate? What are the reasons for lack of balance between labor and other factors of production?
2. Describe the adjustments that could be made on some farm in your community to use effectively the different amount of family labor that would be available as one or two boys grew up and after they left home.
3. For this same type of farm, describe the adjustments in farm organization and operation (1) to use effectively the time of one regular hired man on a farm which would ordinarily not require quite this much regular labor, and (2) to operate with only one regular hired man on a farm which would ordinarily require a little more labor than the operator and one hired man could supply.
4. How much variation exists in the monthly wages of hired men in your community? Is there an economic basis for this variation?

CHAPTER XXVII

The Management of Land

LAND, LIKE THE OTHER FACTORS OF PRODUCTION WHICH WE HAVE been considering, has its own characteristic behavior in production processes and its own management problems. Many of these problems, however, are highly technological in their nature and must be dealt with by agronomists and soil scientists. Those analyzed here all have important economic aspects. They are such problems as the intensity of use of land, the level of fertility at which soils are most advantageously maintained, and the amounts that can be economically invested in improving the land. We all know land when we see it — although we may at times have difficulty in deciding whether a swamp, or a tidal marsh, or even a shallow pond, is land or water. But many of us do not appreciate that land includes not only the earth's surface, *but the natural properties that are associated with it, the air above it, the sunlight, the climate and rainfall, the winds, etc.*, insofar as these affect the use of the land as land. Land, moreover, may have properties which it has not derived from nature but were man-made. All that is necessary is that the man-made properties behave like nature-given properties. The plant nutrients added to soil artificially behave in production in much the same way as the nature-given plant nutrients. Similarly, a tract of land which has been artificially leveled is little different presently from a naturally level tract. Such a definition of land will not appear fanciful to men of the world. When they speak of land they mean exactly this.

We need also to make sure that all of us think of the soil as including everything down to bedrock. Annual crops may send their roots only to the topsoil or solum, but the roots of shrubs and trees reach well down into the subsoil or C horizon, and the subsoils serve not only as a reserve of mineral plant nutrients but also as a reservoir of ground water. The soil thus constituted functions in production as follows:

1. Supports the plants so that their leaves are exposed to the air and sunlight, and supplies the medium through which the roots of the plant are able to reach the needed plant nutrients, air, and water.

2. Supplies the growing plant with nutrients out of a supply that it has stored from other years, contributed either by nature or by man.
3. Catches the rainfall, stores it, and gives it back to the plants.
4. Absorbs the heat from the sun which is needed for soil building and for the conversion of soil material to available nutrients.
5. Furnishes a medium within which physical, chemical, and biological processes take place that convert into available plant nutrients the materials in the soil (including air and water), the fertilizers, lime, and manure applied to it, and the decaying surface vegetation; likewise, a medium for the processes by which the parent materials are converted into the "true soils" of the solum, and much more slowly, the bedrock is converted into parent material.

Popular notions about soils run altogether too largely in terms of the second function of the soil, as a storehouse of plant materials to be drawn upon by growing plants and replenished as needed by man. The German soil chemist, Justus von Liebig, helped establish this conception of soils. But perhaps his help was not needed — perhaps it was a natural assumption for a human being to make. As a result, the prevailing tendency is to grade land as poor to excellent largely on the basis of the supply of the chemical plant nutrients contained in it. The soils professors have been telling their students for twenty-five years or more that soils are much more than this, but with not too much success. Apparently, it is one thing to teach the newer soils science in the classroom and something very different to get it applied in the analysis of practical problems.

THE ECONOMICS OF LAND USE

Before we can settle down to the analysis of the problem of land management, we need to consider the economic relationships underlying them, just as we did in the case of farm equipment and labor.

THE PRODUCTIVITY OF LAND A good way to start out on such a quest is to ask ourselves what makes land productive. The quick answer to such a question is that the fertility of the soil gives land its productivity and determines differences in its productivity. But if we dwell upon the subject a little, we presently realize that some poor lands, so far as plant nutrients are concerned, are high priced. They may be located near to a large urban demand for fresh vegetables or milk. Surely it is not fertility that makes the high value of the land in the dry-lot dairy farms around Los Angeles. So much commercial fertilizer is used in growing Florida's oranges and other crops that some soil chemists recently were led by

this fact into the error of figuring that 85 per cent of the total value of the state's crop comes from commercial fertilizer. But still some of these lands are high priced. It is the value of what this land contributes to a product that determines its productivity, and this depends on the demand for the product as well as on the physical character of the land, upon the location of the land as well as on the character of its soils, upon properties of its soil other than the plant nutrients stored in it, and upon the supply of land with these properties in relation to the demand for products requiring these properties.

The significance of this statement becomes apparent if we consider briefly a number of soils in this country. Take first the Caribou silt loams of Aroostook County, Maine, which we learned about in Chapter VII. These will produce 120 bushels of potatoes per acre for a short span of years with no commercial fertilizer; but with just the right amount of liming, clover plowed under to produce humus, and an application of one ton of 5–8–7 fertilizer costing $50, will yield 350 bushels of potatoes per acre, of which 90 per cent will grade U. S. No. 1.

The soils of Seabrooke Farms of New Jersey, managed by Dr. Frank App, furnish an even more striking illustration. In discussing these soils before the International Management Congress in 1938, Dr. App spoke of them as being light sandy loams, almost pine barren soils, in fact; and yet he argued that they might be able to out-compete much of the truck land of the southern states in the production of canning crops. Location with respect to markets is a factor in the success of Seabrooke farms. But more important are the texture and drainage of the soils, the climate and rainfall, and of course skilled management.

A soil of much more importance in the national economy is the Norfolk fine sandy loam of the Southeast Coastal Plain. Here is a soil low in plant nutrients under natural conditions, but so highly responsive to management that it is one of the best soils of the nation from an overall agricultural standpoint. Its low natural supply of nutrients is of little significance. Much more important are its adequate rainfall, sunshine, and long growing season, and the structure of its surface horizons. Water enters this soil easily, and while the lower soil holds a good supply between rains, it allows the excess to drain away. With the use of lime and fertilizers, and manures, green manures, and cover crops to maintain organic matter, large yields of many crops are obtained at relatively low cost because the soil is so easy to handle. Compare this soil with the Iredell soils in the same region. These have a higher content of plant nutrients under natural conditions, but they have a poor structure and are exceedingly difficult to manage even on gentle slopes.

The soils in western North Dakota illustrate the same principle. The soil types there vary a good deal locally in their productivity for wheat under current practices, not because of their supply of nutrients, but because of textural and structural differences which influence the entrance of water into the soil, its retention, and its delivery to plants when they need it.

It is now apparent that the productivity of land can be expressed very well in terms of capacity and efficiency for fertilizer and for the other input factors. Land being the fixed factor in such combinations, it appears as the top rectangle in charts like Chart 61 in Chapter XVIII. The Norfolk soils have a larger net productivity rectangle than the Iredell. The net productivity rectangle for a Black Prairie soil which yields 45 bushels of corn per acre with only small applications of fertilizer per acre, larger ones not seeming to help any, may not be larger than that for a Gray Brown Podzolic soil that yields 3 tons of alfalfa per acre and excellent silage and pasture when kept in a good state of fertility by liming and manuring. The Prairie soil is the more efficient in the use of fertilizer, but has small capacity for it. The net product for the sandy New Jersey soils may be higher than for the Prairie Soils because their location causes much more labor and capital to be applied to them.

The Soil Survey began some twelve years ago to make ratings of soil types according to their productivity for crops. One rating was in terms of inherent productivity. This was supposed to represent the yield of crops from the soil with the natural supply of plant nutrients when the soil had been cropped only a few years, before the natural supply of plant nutrients and organic matter was exhausted. It also made a rating under *current* practice, which was defined in each case in physical terms according to the management practices followed by the majority of successful farmers, which was generally better than average but well below the best.[1] The Soil Survey has since found the concept of inherent productivity difficult if not impossible to apply. Instead, the recent releases of the Soil Survey give productivity ratings for soil types under several physically defined systems of management, wherever adequate data can be assembled. The translation of these ratings into economic terms must take account of predicted costs, prices, land values, and so on. Some of the ratings are given in terms of a percentage of a standard, and some directly in terms of bushels. In using them in farm planning, one needs to know the yields, but in making comparisons between soils

[1] *Soils and Men*, pp. 1011–1015. Also see Ableiter, J. K., "Productivity Ratings of Soil Types," pp. 13–24, in *The Classification of Land*, Missouri Bull. 421, 1940.

growing different crops, or analyses of comparative advantage in production, the ratings in percentage are useful.

Productivity of land is normally figured per unit of area. In fact, the tendency is to assign too much importance to area. With the cheapening of power that has occurred, increasing speed of travel, and rubber treads, area is far less important than it was. The number of plows or discs or harrows hitched to a tractor can be increased and a larger area covered in the same total time. The cost of the extra investment in equipment needed has been reduced by the lowering of the interest rates. For some important purposes, the productivity of land needs to be measured *per man unit* and not *per acre — in terms of the net product from the amount of land that one man can handle.* The ranching lands of the West are low in product per acre, but may yield higher incomes per operator and per worker than the dairy-farming lands and even the Corn Belt land of the Midwest.

INPUT-OUTPUT RELATIONS A few points need special consideration in figuring input-output relations in the use of land. One of these is that the variable input, fertilizer, is of the same *general* nature as the plant nutrients already in the fixed factor land. When a piece of land is rented, what is paid for is the plant food already in the soil which can be utilized in the growing of a crop. It may be natural plant food, or plant food that has been put there by previous applications of fertilizer. This much plant food is *land input* comparable with the machine inputs which we analyzed in Chapter XXIV, and any of it that is used up is considered a depreciation of the land. The new fertilizer which is applied can be considered as a variable *crop input.* The land inputs are paid for under prevailing practices in the rent; the crop inputs are not. The only difficulty with this procedure is that the fertilizer applied is not all used up by the crop grown, and some of it is fixed in the soil and never becomes available for plants. This makes it necessary to determine, if possible, what part of it is still unused and still available and subtract this from the fertilizer input. Experiments have been carried on in various places to determine what part of the fertilizer is used up by each successive crop, or fixed in the soil. The same complication arises with labor applied to land. The common practice is to charge all of it to the crop cultivated; but obviously some part of it should usually be subtracted and carried over to the succeeding crops. Also, the clovers and other leguminous plants, while taking some plant nutrients out of the soil, actually add nitrogen to it by taking it out of the air, and there may be no net depreciation at all. Similarly, the contribution of small-

grain crops as nurse crops for clover and grasses should really be counted as part of the output of the grain crop.

It follows from the foregoing that the addition of fertilizers to any crop saves a good part of the depreciation of the land. What usually happens is that the supply of some plant nutrients is reduced by the crop, while the supply of others is more than maintained by the fertilizer applied. When fertilizers and lime are applied only at intervals, as is often the case with phosphates, the process after the first year is likely to be depreciation. A good fertilizer program, however, can build up the soil over the years by correcting defects resulting from prolonged overcropping, leaching, and the like.

Farm land may *appreciate* in any of the following ways: from the addition of fertilizers or lime; from cultivation, resulting in improvement in tilth; from eradication of weeds; from growing crops which add nitrogen to the soil; from plowing under green-manure crops; from drainage; from leveling; from removing stones or stumps and brush. It may also appreciate, of course, from the growth of a near-by city and improvements in markets, and from a rise in the price of its products. Conversely, it may *depreciate* from the growing of crops upon it which use up its plant nutrients; from erosion; from becoming weed-infested or disease- and pest-infested; also from a deterioration of markets or a decline in the price of its products. It is clear, therefore, that at any given time a piece of land may be either appreciating or depreciating. What we have to deal with is really a *net* appreciation or depreciation.

Land has in general no fixed depreciation. It does not depreciate standing idle. Over long periods of time, most land will actually appreciate if left alone. If it is a prairie country, it will accumulate more humus. If it is a timbered country, it will grow heavier forests. Over short periods, however, some land will appreciate and some will depreciate. If in grass, it will benefit from lying idle except where leaching is serious. If in brush, like most of our cutover land, it may become more difficult to clear from year to year, but it may also be growing another stand of timber. Our so-called abandoned lands of the East are mostly appreciating, because they are going back to timber which is their most advantageous use.

A corollary of the foregoing is that under ordinary circumstances land never entirely depreciates. It can be cropped until it has no further value in this use, but ordinarily there will be other uses for it — if nothing else, growing a new crop of trees. In the South, much of the badly eroded land can be planted to kudzu or lespedeza sericea.

In this connection, the distinction between mining and farming is interesting. In mining, the materials of the earth are taken away and will not be replaced within ordinary reaches of time; they will be replaced only in the geological sense, and in many cases not even in that sense. The land or earth surface still remains, but its valuable materials are mostly gone and are irreplaceable. In agriculture, on the other hand, although the growing crops take plant nutrients out of the soil, these can be replaced, and are replaced in a very practical way, so that the valuable properties of the soil can be maintained at the desired level; or even if removed, can usually be restored at some subsequent date; and this restoration will not involve a complete rebuilding, such as the restoring of a building would.

When we buy a piece of land in the legal sense, we buy the land improvements that go with it, such as the tiling and the ditches, and the land fixtures such as the fences, roads, and bridges. We buy the buildings and growing crops upon it also. Land improvements can be separated from land proper for the most part only by their origin, since they perform so nearly like it in the production process. Land fixtures, however, start out on their useful careers as completed capital goods, and depreciate from the first use till they are worn out, unless in part or in whole renewed occasionally. Tile drains and ditches are better classed as land improvements than as land fixtures.

Finally, the fixed inputs, interest and taxes, figure more largely in land costs than do depreciation and upkeep. In other words, the interest on the value of the plant nutrients in the soil is a larger item than those taken out by any crop. This means that the ultimate supply of plant nutrients available in the soil is great in comparison with what is used by any one crop. This is true largely because it is presumed that they will not be wastefully used, but will be conserved by rotating crops, by keeping livestock, and by using fertilizer to supplement the plant nutrients in the soil and keep them properly balanced.

THE CONSERVATION OF LAND The next logical step in our analysis is conservation. Obviously, this is just an extension of appreciation and depreciation. According to some popular usage, if land is conserved it cannot depreciate at all. A more rational use of the term conservation admits depreciation provided it is offset by appreciation within a short space of time. But even this use of the term does not cover the essential concepts. Land, after all, is not conserved for its own sake. Instead, if some present use of it is restricted, it is in order to get future uses out of it. The essential idea in conservation is the *balancing of present uses*

and income from land against future uses and income so as to get the most out of it over the whole period.

There is still, after this definition of conservation is accepted, plenty of room for differences of judgment as to what rate of use is best in the present. Some will figure in terms of a shorter time-span than others, being willing to let the not-distant future look out for itself. Some will favor maintaining the productivity of the land on a higher level than others over whatever time-span is chosen.

THE MAINTENANCE LEVEL Much of the land in this country can be maintained at any one of a wide range of levels. That used for growing potatoes in Maine can be kept at a fertility level that will yield anywhere from 125 to 350 bushels. Land in the Upper Coastal Plain of the Carolinas can be kept at a productivity level anywhere from 150 to 550 pounds of cotton per acre. An 80-acre dairy farm in southern Wisconsin can be kept at a productivity level that will support as few as ten cows, or perhaps as many as twenty-five if the home-grown grain ration is supplemented by some purchased concentrates. In the first case, the rotation system consists of corn, oats, timothy, and clover, and none of the corn is made into silage. In the second case, heavy applications of lime and fertilizers are made, alfalfa is substituted for clover and timothy, and most of the corn goes into silos. The yields per acre steadily rise to the higher level under this more intensive system.

The decision as to the level at which to maintain fertility is partly determined for each farm separately because of the special conditions on that farm. A family which has inherited more land than it can maintain at a high level of fertility without employing hired labor, or more hired labor than it prefers, is likely to adopt the more extensive methods; likewise are the farmers whose boys have grown up and left the farm. The family that has less land than it can work at optimum returns may do either of two things: build up the fertility of what it has to a relatively high level, or deplete the land by overcropping.

The inclination of the agronomist is to favor the maintaining of the productivity of the soil at high levels; also of many of those with an unthinking bias toward "conserving" the land; and of most lay observers. The operating farmers may come in for much criticism because they do not maintain the productivity of their land at the higher levels. Frequently they are compared unfavorably with the farmers of Europe. The principal reason that they do not farm at these high levels is the economic one discussed in Chapter XX on "Adjusting Farm Production to Markets." This is very aptly illustrated in most of the milksheds

of the Northeast. If all the farms producing market milk were to adopt the more intensive systems of farming and maintain their land at a high level of productivity, a large fraction of their milk would be sold at cream prices, and the average or "blended" price for their milk would be so low that they would receive lower incomes. Enough of them do follow the more intensive systems to lower the blended price to a point that it discourages others from doing so. If all of the butterfat producers in the Midwest adopted the intensive high-level methods of farming, this country would have an export surplus of dairy products unless measures were introduced to distribute them to low-income families in this country. The agronomists of some Southern states have been telling their cotton farmers that only by growing a bale of cotton per acre can they make any money. This is all right as long as only a few take their advice. If all the land capable of producing a bale of cotton per acre by maintaining its fertility at a high level was to be so managed, the price of cotton would decline to an impossibly low level. Enough do obtain the high yields to lower the price for the others to discouraging levels. The Europeans maintain high fertility levels because they have outlets at home for all the food they produce.

In much of the United States, however, the land can advantageously be maintained at a higher level of fertility than prevails at present. During the long stretch of years while the virgin fertility of our soils was being exploited, our farmers established traditions and habit patterns which they are now continuing over into a period to which they are no longer suited. In many parts of the East, when they had reduced the fertility of their first fields to a point where it no longer paid to grow crops on them, they cleared additional fields and let the first fields either recuperate or revert to timber. When they had thus exploited all of the land on their farms, they pulled up stakes and moved to the frontier. This process set in all over again in many parts of the Midwest and West. Of equal importance is it that new technologies now make it possible to maintain relatively higher levels of productivity at greatly reduced cost, but the farmers of this country are just now adopting them. Such techniques as cover cropping, green manuring, and contour cultivation are certainly not yet a part of the skill and knowledge of our great body of farmers. If the farmers knew how to use these techniques, they could afford to maintain their land at a higher productivity, and their cost curves would not rise so sharply with increased outputs. They could produce and sell more than now at lower prices. One of the large advantages of keeping land at a high productivity level is that it then has a wider range of alternative uses.

The level at which it pays to maintain the productivity of a farm is not a matter for exact determination, since only by projecting prices of products, wages, and other cost-rates over the time-span chosen can it be figured. The procedure for doing it is simply to set up budgets of anticipated receipts and expenses, at the projected prices and cost-rates, with the farm operated at different levels of yields and outputs — at what we shall presently call different *intensities of cultivation.* The outputs must of course include those of the livestock as well as of the crops.[2] Unfortunately little information is commonly available as to the simple physical aspects of productivity levels. We know in only a limited way, for example, how much the yield of alfalfa can be increased by various rates of application of lime and phosphate continued over a ten-year period.

Another major difficulty in such determination is that of knowing what effect different uses of the land will have on future yields. Not much information is available on this subject. An interesting attempt at such measurement was made by F. L. Morison and J. I. Falconer of the Ohio Experiment Station.[3] Previous research had furnished a basis for the following schedules of effects on the productive capacity of the soil:

Corn — 2 per cent depletion for each crop.
Wheat — 1 per cent depletion for each crop.
Clover — 2 per cent added.
Alfalfa — first year after seeding, 2.5 per cent added.
Timothy — neutral (no effect either way).
Manures and commercial fertilizers — according to amount applied.

With this schedule it was possible to estimate the net effects of the cropping systems followed on 696 farms in ten areas. Only 15 per cent of these had a zero or plus "soil productivity balance." This means that they were not, in 1936, *following a farming system that would maintain the level of productivity that had been prevailing*. This may indicate that the level was too high for the low farm prices of 1931–1935.

This raises the question as to the policies to be followed in maintaining a given productivity level once it has been chosen. Should a farmer keep his farm as close as possible to this level at all times, or should he feel free to make adjustments above and below it to fit temporary circumstances? The nutrients used by crops can be easily replenished in

[2] The net incomes for these different levels can, if it is desired, be converted to Present Worths by the formulas presented for valuing farm property in Chapter XXXIII.

[3] F. L. Morison and J. I. Falconer, *The Relationship between Soil Maintenance and Profitable Farming*, Ohio Bull. 604, 1939. Also A. W. Klemme and O. T. Coleman, *Evaluating Annual Changes in Soil Productivity*, Missouri Bull. 405, 1939.

full or increased under nearly all circumstances, provided the soil itself is not carried away by erosion. Likewise can the structure, the humus content, the pH, and other necessary properties of the soil be restored in most cases, again assuming that erosion has not been carried too far. Therefore, although it may be most economical to do so in the long run, it is not necessary to maintain the soil at the chosen level of productivity at all times.

Rotation systems almost inescapably include alternating depreciation and appreciation. For example, a five-year rotation consisting of corn–corn–oats–hay–pasture includes three years of depreciation followed by two years of appreciation. The manure is usually applied with the first corn crop. A rotation common in more northern latitudes represents the opposite of the foregoing; the land is plowed and cropped for one to two years with an annual small-grain or root crop or corn, then reseeded and kept in meadow and pasture for five to ten years. In such a rotation, the land is deteriorating during the latter part of its meadow and pasture phase, unless lime and fertilizer are freely applied, and is appreciating during the cropping and reseeding phase. Some land is kept in meadow and pasture so long that it never returns to crops. This happened on a large scale in England in the period when the area of arable land was declining. It happens in the Northeast whenever farms are allowed to run down. In the mountainous areas of the South, one finds a much longer cycle in operation. The land is cleared and cropped for five or ten years until it will no longer return much more than the seed and then it is allowed to grow back into brush and then trees, to be cleared again perhaps forty years later. It is doubtful, however, if this form of rotation can be continued indefinitely, because the severe erosion on the highly sloping fields has used up very rapidly the relatively shallow B horizon and parent materials.

The periods of depreciation and appreciation through which much of our land has passed, however, have mostly been for other reasons than that of the rotation of crops. Some of them have been associated with tenancy. Relatively few of the farms in this country are operated by tenants generation after generation. Instead, they go through a period of operation under ownership during which they are likely to appreciate and then into a period of tenant operation in which they may depreciate. When farms are kept in tenant operation continuously, the landlords are likely to have learned the necessity for maintaining the soil. Farms are also sometimes overcropped for a period while the owner is trying to reduce his mortgage debt or during some other emergency.

In many parts of this country, farms depreciate in the period when their owners are advanced in years and unable to farm vigorously. This is particularly serious in areas where the land needs to be limed and fertilized and reseeded from time to time because of its propensity to leach. Many farms in the Northeast have gone through periods of this sort. In a few hundred thousand cases, the depreciation was carried to a point where restoration was too costly to undertake. By this process, farming was abandoned on seven million acres in the New England states alone between 1880 and 1940.

When a period of depreciation sets in, there is always danger that it will not be stopped in time. From the standpoint of strategy, the simple and safe rule would therefore be to *establish the optimum level of productivity for any given piece of land, and to keep close to it except for minor temporary departures above and below in rotation cycles.* Following such a rule, however, will not maximize returns in and out of a big depression, or under other circumstances calling for the major agricultural adjustments outlined in Chapter XX.

The problem takes on another form on much of the land that has been farmed for two hundred years or so in the East and South. Apparently this land has to be maintained in a relatively high level of fertility or else used for timber growing. If an attempt is made to farm it at an intermediate level, it will run down. In recent attempts at land classification, the land in some of these states has been put into four classes or grades. Fourth-class land is that which is in timber and should be kept in timber. Third-class is that which was in crops and pasture but seems to be returning to timber use. But much of this third-class land will maintain good pastures and large tonnages of hay if it is limed, fertilized, and plowed and reseeded every five to seven years. It will not remain in farms under any system of use less intensive than this. Whether such intensive use of this type of land offers sufficient income inducement to keep farmers on the land depends upon the demand for the product and progress made in the arts and science of farming such land. In the Northeast, the answer will depend upon future developments in the demand for dairy products and in part upon how soon the techniques for maintaining the fertility of this land can be developed and learned by the farmers. One of the difficulties in such a situation is that the farmers during the fifty years following the Civil War experienced a decline in their prices and continued abandonment of their land, and as a result acquired a defeatist attitude toward their land. As we shall see in Chapter XLVI, the people of this region are slow in learning the techniques of timber management.

Another special case is that of virgin lands. These lands may be so rich in humus and nitrogen that it does not pay to maintain them indefinitely at their virgin level of fertility.[4] Instead, it may be not only the best individual economy but the best national economy to appropriate some of this virgin fertility; in other words, to mine these soils for a while. In such a case, however, a decision must be made as to the maintenance level below which they should not be mined and which should be perpetuated once the period of exploitation is over.

Whether or not it pays to exploit virgin soil resources depends mainly upon other circumstances. If the country is all new and in the process of being developed, it is much more likely to pay than in a country already developed. In other words, it may very well have paid to exploit the alluvial soils of the Red River Valley in the seventies and afterwards, but it may not pay to exploit in similar manner some alluvial soils that are now made available as a result of irrigation developments. When the country was new, the prevailing prices reflected the general practice of exploiting all kinds of virgin resources. The prices of today reflect much less dependence on virgin fertility.[5]

A simple approach to the problem of fertility level for virgin lands is to estimate their optimum maintenance levels in the manner indicated above and *then see how the fertility above this level can be best used in the exploitation stage.*[6] It is possible to crop such land heavily and use up all the excess fertility within a short span of years, or to stretch it out as a sort of reserve over a very long period. In most cases today, the latter course will prove more nearly the best. Nevertheless, on perhaps 75 million acres of still somewhat virgin lands in the United States, the first course is being more nearly followed.

[4] In fact, it is virtually impossible to keep them at this level if they are plowed and cropped.

[5] General Francis A. Walker, the leading American economist of his time, who became the director of the Census of 1880, wrote as follows in his introduction to Volume III of the Agriculture Census, "Down to this time our apparently wasteful culture has, as I have sought to show, been the true economy of the national strength; our apparent abuse of the capital fund of the country has, in fact, effected the highest possible improvement of the public patrimony. Thirty-eight noble states, in an indissoluble union, are the ample justification of this policy. Their schoolhouses and churches, their shops and factories, their roads and bridges, their railways and warehouses, are the fruits of the characteristic American agriculture of the past.

But from a time not far distant, if indeed it has not already arrived, a continuance in this policy will be, not the improvement of our patrimony, but the impoverishment of our posterity. There will be all the difference between the past and the future, in this respect, morally, economically, and patriotically considered, which there is between the act of the strong, courageous, hopeful young man who puts a mortgage on his new farm that he may stock it and equip it for a higher productiveness, and the act of the self-indulgent man of middle life who encumbers his estate for the purpose of personal consumption."

[6] For a more formal analysis of this problem, see Chapters VI and VII of Arthur C. Bunce's *Economics of Soil Conservation.*

INTENSIVE VERSUS EXTENSIVE CULTIVATION Most of the debate as to the relative merits of intensive and extensive cultivation, or of high farming versus low farming as they are called by the English, is beside the point, for degree of intensity of land use, like size of farms, is largely determined by the man-land ratio in a country. Some aspects of this question, however, need to be examined from a farm management viewpoint. Principally, we need to distinguish between intensity measured in terms of labor used per acre, or more accurately, labor and capital goods per acre, and that which, for want of a better term we shall call *physical* intensity. Labor intensity and capital intensity need frequently to be considered separately; but also at times they need to be combined in a single unit. This can be done only by converting them to dollar values of input. A dollar spent on mule power figured in this way, however, is not equal in productivity to the dollar spent on tractor power, for the tractor dollar turns over or cultivates much more land than the mule dollar. It has been estimated that a half of a kilowatt-hour, costing 2.5 cents, will pump as much water as a man working with a hand pump for ten hours. As stated earlier, an abundance of tractor power makes it possible to prepare seedbeds more thoroughly, cultivate more often and more promptly after rains, and to harvest a crop more nearly at the right time. With such equipment, the land is more intensively farmed though the dollar inputs may be much less. No doubt, most wheat farming in the West is more intensive in the sense just described than the wheat farming done with horsepower thirty years ago.

The feed inputs of a horse or cow, whether in the form of corn fodder, alfalfa hay, bran, or oil meal, can all be reduced to a common T D N basis that measures roughly their contribution of feed energy to the animal. A similar common measure is needed for the contribution to a crop of an hour of hand labor working with a hoe, an hour of labor performed by a man and a mule and a walking cultivator, and an hour of labor performed by a man with a tractor pulling three plows.

"SUBMARGINAL" LAND, "UNPRODUCTIVE" LAND, ETC. Much confusion in land-use analysis has been caused by describing some land as "submarginal" or "unproductive." It is hard to find an acre of land that does not yield some kind of product. But does it yield a *net* product? The answer is "yes," provided it is properly used. If net losses result year after year, the land is being improperly used. Likewise, there is no such thing as "submarginal" land; what we have instead is much *submarginal use* of land. If as the rainfall declines westward, or the struc-

ture or drainage of a soil becomes poorer moving from one field to another, the land use changes as it should, no net losses result.

When in 1933 and afterward L. C. Gray, H. R. Tolley, and others were trying to develop a land-use program for this country, they came eventually to the point of refraining from the use of the term submarginal. Instead, they talked about "problem areas." They came to assume that every piece of land has a best use, and to conceive of their task as finding out what this use was. More often than not, it was some other agricultural way of using the land. In other cases, it was a combination of crops and grazing, or of crops and forestry, etc. They were looking for readjustments that needed to be made and not for opportunities to "abandon" land.

The actual product of a tract of land of course depends upon the way in which it is used. Much land is not now combined with other factors of production in such a way as to release its full economic productivity. This is illustrated by the use of the land in two counties close together in Illinois — Douglas and Jasper. In 1940, the gross production on the average farm in Douglas County was $3,530, in Jasper County, $965. Douglas County lands are commonly described as having high productivity and Jasper County lands as having low productivity. The average farm in Jasper County, however, contains only 120 acres as compared with 184 in Douglas County. To include within a farm boundary as much productivity, measured in terms of chemical nutrients, in a Jasper County farm as in a Douglas County farm would require 380 acres. A farm of 380 acres of this kind of land is most advantageously used in growing grass and hay to support a livestock system of farming. So used, it might very well yield as large an income as the Douglas County farm of 184 acres. Most of the so-called submarginal land in this country is merely land which is being farmed in units too small.

The Illinois Agricultural Experiment Station has rated 76 per cent of the land in Cumberland County, next adjoining Jasper and having the same claypan soil, as 8, 9, and 10 in its system of grades running from 1 to 10; and yet in a special study devoted to the problem of this type of land, it is made very clear that the major difficulty is with the misuse of the land. "The use made of the crop area appeared to have little relation to the productive capacity of the land . . . cropping practices too intensive for the soil were found everywhere in the county. . . . On the small farms, where the best practices are most needed, there was a dearth of good practices." [7]

[7] *Farming in Cumberland County in the Claypan Region of Southern Illinois*, by R. C. Ross, V. B. Fielder, and G. H. Walter, Bull. 506, pp. 293, 295, 297.

THE SUPPLY OF LAND One other major economic factor needs to be introduced into this discussion of the economics of land use; namely, that the supply of land is definitely limited in any one general area, and to some extent in the world at large. Land cannot be freely reproduced as can machines, livestock, and the like. Additional land can be brought into use, but only within easily-attained limits. Moreover, the additional land is in most cases either not so desirable or not so accessible as the present supply. As a corollary of the foregoing, the better grades of land cannot be reproduced freely. The grade of most land can be raised, but also only within definite limits. Since grades of capacity and efficiency of land cannot be freely reproduced, the existing differences are especially significant. He who takes possession of a better piece of land than his efficiency fits him for, is taking it away from some better person. If it were a machine, another could be manufactured. On the other hand, there is usually a supply of unappropriated relatively unproductive land to draw upon. In contrast, no one deliberately brings into existence a supply of machines of very low efficiency.

In this connection, the terms *intensive margin* and *extensive margin* are often used in such a way as to create confusion. They are not opposites like intensive and extensive cultivation. They are not even two margins, but *two ways of looking at the same margin.* When the approach is from the standpoint of the last unit of input that just pays for itself on a given type of land, we speak of the intensive margin. In the east-to-west continuum with declining rainfall, there is always a grade of land just a little lower that will not use quite so much labor and capital without incurring a net loss. At the exact point where this begins, is the extensive margin when using *this amount of labor and capital.* Or given this particular piece of land, there is always a slightly larger input of labor and capital which will not quite pay for itself. At the exact point where this begins, is the intensive margin for this particular land.

However, it is correct to say, as did Ricardo, that the intensive and extensive margins are in competition with each other. Farmers generally have the choice of applying more labor and capital to the grades of land now in use, or of applying the same labor and capital to poorer land not now in use.

MANAGEMENT PROGRAMS

With the set of economic relationships just outlined as a background, let us now consider briefly the various phases of the land management problem as it presents itself to a farm operator. The core of most farm

that many of the crops grown in these high-turnover systems have to be grain crops that have no broad market except as livestock feed. Accordingly, someone must grow livestock if these crops are to have a market. As standards of living have risen, the premium on livestock production has increased. It is likely to increase further in this country and also in western Europe. Einar Jensen has pointed out how the prices of butter, pork, and beef, and of the feed grains, rose relative to the prices of bread grains in western Europe from 1855 to 1895 when food production caught up with the population increases, making it possible for the people to eat more meats and butter.[8]

FERTILIZERS Methods of determining the most profitable amount of fertilizers to use have also been thoroughly explored in earlier chapters. The chapters in PART FIVE will present some curves of fertilizer input-output relations for cotton and wheat. About the only other curves that can be constructed from data are for nitrogen applied to corn and oats in Mississippi and South Carolina; nitrogen to Sudan grass in Alabama; nitrogen to timothy, and a complete fertilizer to wheat, in Ohio; and nitrogen to tobacco in Maryland.[9] Dr. Frank W. Parker, head of the Division of Soil and Fertilizer Investigations, assisted in making this survey of the literature on this subject. The list is not complete, but it is nearly so. Elsewhere, the trials commonly take the form of using no fertilizers on the check plots, and one quantity of N, or of P, or of K, or one of the three possible combinations of these, as in the trials extending over 30 years in South Dakota,[10] or of combinations of these with livestock and manure, as in the Kentucky trials.[11] Bailey E. Brown summarizes 171 tests in seven states on the use of complete fertilizers on potatoes by giving the results with and without fertilizers, as little as 600 pounds being used in some states, and as much as 2,000 pounds in others. The results vary widely with soil types in the same states.[12] The results presented in the surveys made by the National Fertilizer Association are averages of the judgments of farmers using fertilizers as to how much less their yields would have been if they had used no fertilizer, without reference to the amounts used.[13]

[8] Einar Jensen, *Danish Agriculture, Its Economic Developments*, p. 217*ff.*

[9] Mississippi Bull. 348, South Carolina Bull. 283; Alabama Circular 79; Ohio Bull. 603; U.S.D.A. Tech. Bull. 414, 1934.

[10] Joseph G. Hutton, *Thirty Years of Soil Fertility Investigations in South Dakota*, Bull. 325, 1938.

[11] Geo. Roberts, E. J. Kinney, and J. F. Freeman, *Soil Management and Fertilization for Tobacco*, Kentucky Bull. 379, 1938.

[12] Bailey E. Brown, "Effect of Fertilizer on Potato Yields," *The American Fertilizer*, Jan. 2, 1943.

[13] *American Fertilizer Practices*, Second Survey, 1939, pp. 12, 70.

The farmer must therefore rely largely on his own judgment, and his own experience, as to how much fertilizer to use. He may get some useful guidance from his experiment station as to whether to use any at all on his particular soil type, and as to what fertilizers to use; but the amounts reported as used in experiment station trials can be taken only as amounts to start with on a particular farm or field. Ordinarily a farmer will learn sooner what amounts to use on different crops and fields if he will use lesser and larger amounts than this on representative strips. The differences in yields in any one year may be strongly influenced by the weather.

Feeding soils commercial fertilizers freely is one of the ways of obtaining a high turnover in the soil nutrients. This is particularly true of nitrogen which produces most of its effects in the first year. On many types of soils, however, applying large quantities of nitrogen may appear to maintain yields while the soils are really deteriorating from erosion or for other reasons. The program promoted by the T V A of applying lime and phosphates to encourage the growth of legumes, provides nitrogen while at the same time improving the soils in other ways. It may, however, appear to reduce the turnover and current output more than many families or small farmers can afford. A judicious use of nitrogen on the level lands on such farms may increase their output enough to relieve the pressure to increase the turnover on the sloping fields. At the same time, the productivity of the sloping lands in legumes and grass forage can be raised to higher and higher levels by the application of more phosphate and potash, with lime as needed.

Finally, there is always the strong possibility that many farms can produce their fertilizers cheaper than they can buy them, by green manuring, especially with legumes, and by feeding dairy or beef cattle or sheep and returning the plant nutrients to the soil in manures. A turnover and output per acre high enough for a good living is possible with only green manuring and livestock, and occasional applications of lime and phosphates, plus potash in some areas, on most of the farming lands in the Midwest and beyond, if erosion can be kept within bounds.

TILLAGE The principal function of tillage is to kill weeds, but the rate of turnover of soil nutrients is also influenced to some extent by the amount of tillage. Working the soil aerates it, thus hastening the oxidation of its humus. It probably makes the plant nutrients more available to the plants. It also helps the roots of young plants to penetrate the soil. It also improves the drainage of heavy soils. Tillage thus makes it possible to use up the plant nutrients a little more rapidly.

Commonly it also works a little of the subsoil in with the topsoil each year and thus gradually makes available more of the minerals in the subsoil. This process is seen in its pathological phases in the lighter color of the topsoils on the slopes of hills. Jethro Tull, as pointed out in Chapter VI, discovered that cultivating the soil produces larger yields, but he failed to realize the true reason for this. At the other extreme today are those who are so conscious of the fact that tillage causes plant nutrients to be used or destroyed more rapidly and promotes erosion if the land is the least bit sloping, that they argue against anything more than superficial tillage to kill the weeds and open the soil so that it will absorb the rainfall. They are satisfied to work manure and decaying vegetation into the first few inches of the topsoil. Most soil scientists insist that the plowing under of fertilizer and organic matter is the only practical way of obtaining good yields. They agree, however, that the farmers of today do too much plowing and also cultivating.

The issue is mainly a technological one but it has some economic implications. The superficial tillage involves smaller inputs of power and labor, but probably after a few years larger inputs of fertilizer if yields are to be maintained. On the other hand, the land will deteriorate less rapidly. Probably a combination of the two kinds of tillage is best, the proportions of the two ranging with the soil types and the climate. Heavy soils probably need the deeper tillage and frequent plowing under of green-manure crops. Many of the lighter soils may have too open a texture without any plowing.

Of serious consequence is the destruction of the humus in the topsoil, caused by stirring it freely, in the warmer latitudes where temperatures are higher and the land is not frozen in winter, and crops are grown during most of the year. The extreme example of this in the United States is the rapid sinking of the level of the high-humus drained lands of the Everglades of Florida when devoted to the growing of beans, celery, and other truck crops. Loss of humus is serious in the truck-growing areas of the eastern shore of Maryland and New Jersey, and even in the potato regions of Aroostook County, Maine. It may pay better, however, to cultivate such soils thoroughly and replace the humus by green manuring.

Land kept in grass most of the time receives little tillage and yields up its plant nutrients relatively slowly. In fact, if the cattle running upon it are fed purchased concentrates, their droppings may increase the supply of nutrients in the soil. The roots of the grass plants permeating through the soil may also improve its structure. Land therefore sometimes appreciates while being pastured. Land in hay and sown

crops grown in rotation yields up its plant nutrients more rapidly than when grazed, but more slowly than land in cultivated row crops like corn, cotton, and potatoes.

WATER EROSION More serious than loss of soil nutrients from excessive tillage, or heavy drains by growing crops, can be the loss of the topsoil by water and wind erosion. Space need not be taken here to present the familiar data showing the differences in the amount of topsoil lost on fields of different slopes when in grass, close-sown grains, and in row crops. The differences are large enough to be of high economic importance, and to indicate that row crops are not usually charged with more than a small fraction of the soil-depreciation which they cause, and that grass and pasture may well be charged too much.

The farm management problem presented by these facts is that of balancing the costs of different erosion-control procedures against the losses, and also against each other, to see which yields the largest net return. The costs are in part out-of-pocket and in part represent additional work done by the regular labor force and farm equipment. The safest procedure is to budget the out-of-pocket costs as an addition to the farm expenses, and the effect on yields as expected future cash receipts from the sale of crops or livestock and livestock products. Data on man labor, horse labor and other inputs will help the farmer in deciding whether the gains in net income are worth the additional inputs involved. Unfortunately, very little data of this sort are now available. The amounts written into the budgets will therefore be judgments mostly. But the judgments will improve with experience.

On many farms, a major choice is involved between more extensive systems of farming which depend upon vegetative control of erosion, and more intensive, high-turnover systems which attempt to check the erosion of land in cultivated crops much of the time by means of contour cultivation and terraces. The extreme forms of the latter are the bench terraces used on the steep hillsides of the Orient, made possible only by cheap labor and scarce food. The bench terraces that were built in the last century in the piedmont sections of the South, without which little soil would now be left on a large acreage of land still cropped, are built on less steep slopes than those of the Orient, but owe their existence to these same influences. They are still the only type of terrace which will keep erosion within bounds on some of the steeper of the lands now farmed.

The ridge terraces, especially the broad-base ones, can be fitted to gentler slopes and cultivated on the contour. The work of maintaining

them can be done with horses and tractors along with the regular farm work. They are therefore fitted to the less labor-intensive types of farming that are now developing in the South. They also make possible more flexibility in crop rotations.

Involving less labor in development and maintenance are the strip-cropping systems. They make absolutely necessary the keeping of part of the land in close-sown crops or hay, but are not suited to long rotations including hay for several years, or to rotations including pasture. They do increase slightly the time required in handling the crops, but they reduce power inputs because most of the operations are on the level and not uphill and down.

Requiring the least extra labor of all erosion-control methods are the cropping systems which keep the land in grass, close-grown or cover crops most of the time, and provide for farming on the contour in the occasional years when a row crop is grown. Where these cropping systems provide all the income per farm that the family requires, they alone will solve the erosion problem.

For slopes too steep for ridge terraces, or which have already been gullied badly, the usual recommendation at present is a return to timber, with such planting as necessary. An alternative in the South, however, may be to plant kudzu or sericea. The kudzu provides a much larger return per acre in fewer years, but involves a larger initial investment. The setting of kudzu crowns continued during the war in spite of lack of new seed from Japan. In Alabama, where the Soil Conservation Service made its first trials of kudzu, 43,000 acres were set in Soil Conservation districts in 1942–1944, in addition to the 27,000 acres set previously.

The objective of nearly all methods and devices for controlling water erosion is first to get as much of the water as possible to sink into the soil, and after that to handle what must run off in heavy rains in such a way as not to gully the land. Grassed watercourses and diversion ditches serve this latter end admirably.

These brief observations should make it clear that a wide range of procedures for controlling water erosion are available. The responsibility of the farmer is to choose the ones that are best suited to his slopes, soil types, climate and rainfall, crops, needs for income, and finally, resources of labor and capital.

Considerable of the land now in cultivation in the United States has already been eroded to the point where its topsoil is too shallow for good yields. Such topsoil can be deepened by checking further erosion, by extensive green manuring and free use of barnyard manures and

crop residues, and by plowing up some of the subsoil and mixing it with the new supplies of humus provided. Using commercial fertilizers to obtain a heavier growth of the green-manure crops hastens the process. A vigorous program of this sort can restore the productivity of much eroded land in as short a space as ten years. A slower program will take the form of using crop rotations running strongly to hay and pasture.

To speak of soils as having lost a fraction of their topsoils is therefore somewhat misleading. It implies a definite topsoil layer provided by nature on virgin soils, and the exhaustion of this by cultivation just as a mine is exhausted. The normal depth of the surface soil varies from two or three inches on sloping lands in the East to more than two feet in the prairie soils of the Midwest. Few accurate data on the rate of soil formation are available, but recent evidence indicates that it is much faster than it had previously been thought. The actual inches of erosion is relatively unimportant. What is important is the influence the erosion has had on the soil. The loss of a very few inches of the surface soil might be extremely serious in a soil having a claypan or that is shallow over rock, whereas the loss of two or three feet might not be very serious if the underlying soil material were friable and fertile, and provided the erosion were stabilized. A little erosion will seriously injure soils like the Putnam in Missouri. A good deal of sheet erosion will do little harm to the Memphis loessal soils of extreme western Kentucky and Tennessee, provided it is not continued indefinitely, and provided gullying is prevented.

WIND EROSION The most important of all decisions relating to wind erosion is whether or not to break the sod on a tract of land that may be subject to wind erosion in dry years especially, for once this sod is broken, the costs of getting it back under grass cover again may be greater than most farmers can stand. In effect, the man who destroys such a sod may have committed a depredation of the same order as one who sets fire to a forest. A survey made in 1942–1944 of the two soil conservation districts in Baca County in extreme southeastern Colorado, in the heart of the Dust Bowl, showed that only a third of the land in crops at the time was suitable for any kind of cultivation. The rest should be restored to native grass. Of the cropland idle at the time, all but a sixth should be restored to grass. Of the present range land, an eighth could be cropped, provided strict conservation measures could be applied.[14]

[14] John J. Underwood, *Physical Land Conditions in the Western and Southeastern Baca County Soil Conservation Districts Colorado,* U.S.D.A. Soil Conservation Service Physical Land Survey 30, 1944.

The measures necessary to prevent wind erosion on land suitable for crops in the Great Plains area are: (1) strip-cropping; (2) leaving crop residues and stubble and dead weeds on the land after harvest; (3) methods of tillage that leave "trashy fallow" on the land in the fallow summer and winter; (4) contour tillage of any row crops; (5) listing or ridging of the land to retain as much as possible of the water of sudden rainstorms; and (6) the various water-spreading devices. Whether the extra expense of any of these methods is warranted by the extra returns from the land in crops, and which methods are best suited to any situation, are the problems confronting the farm manager.

For land that yields a bare marginal return in crops under the control methods best suited to it, the farmer needs to consider the alternative of reseeding it to grass, and the relative costs of and returns from different methods of reseeding, about which little is yet known.[15]

WATER CONSERVATION Conserving the water has been treated as an incidental phase of soil conservation in the last two sections. It is deserving of more attention than this. It is, of course, directly connected with soil erosion. If the water is kept on the land, so also are the soil particles. If the surplus rainfall of heavy storms is carried off the land properly, it does not damage the land and the growing crops. But of equal importance in many areas is the fact that keeping as much as possible of the water on the land makes it that much more available for growing crops. Conserving the water is, of course, especially important in the semiarid dry-farming regions. Methods now coming into use in the Great Plains may make it possible to grow wheat with several inches less rainfall than formerly, and at the same time reduce wind erosion considerably. Experiments conducted by H. H. Finnell on the heavy soils of the wheat-growing parts of the Southern Great Plains showed that only a fifth of the annual rainfall became actual soil moisture available for plants, that light summer rains were two-thirds evaporated shortly after precipitation, and that rainfall of more than one inch became runoff unless held in the land by contour tillage or level terraces.[16]

The Midwest also loses considerable moisture badly needed in dry periods in the summer. For the six years 1939–1944, the Illinois Experiment Station reports corn yields 7 bushels higher under contour cultivation than under uphill and downhill cultivation; oats, 7 bushels higher; and wheat and soybeans, 3 bushels.[17]

[15] See Ch. XL.

[16] H. H. Finnell, *The Utilization of Moisture on Heavy Soils of the Southern Great Plains*, Oklahoma Bull. 190, 1929.

[17] E. L. Sauer, "It's Profitable to Farm on the Level," *Illinois Farm Economics*, March and April, 1945, p. 207.

Anywhere east of the 100th Meridian, one of the largest needs for water conservation is on the rolling permanent pastures characteristic of much of this terrain. Little movement of the soil occurs on these pastures except where the vegetation becomes thin and the sod is broken. But the water of heavy storms often runs away in the drains and collects in the low places. It is true that the ground temperatures are in large measure responsible for the drying up of the pastures in July and August; but if more moisture were available, sods would be established that would stand the summer heat better.

Three methods have been developed for dealing with this problem. The first is simply to lime and fertilize the pastures so that they become covered with a dense sod that holds the water better. The second is to establish better grass mixtures, often with more clovers in them. The third is to contour-ridge the slopes. The furrow-seeders that have been developed are useful for all three of these purposes. Little or no data are available upon which to estimate the costs and returns from these practices; but a farmer can easily try them out on a small scale.

LAND IMPROVEMENTS Several of the practices described in the foregoing call for initial investments. A few words need to be said about those which require longer-term investments — clearing, leveling, draining, irrigating, and woodland developments. In economic terms, the income from these is *quasi-rent* rather than rent, like the income from the use of capital goods. It differs from the income from capital goods in that in most cases these improvements do not depreciate completely, but with proper maintenance will yield an income indefinitely. In estimating their value to the farm, one must anticipate their future net contributions to the product, and balance these against their initial costs and upkeep. Their present worth can be estimated like that of buildings and similar improvements.[18] In some situations, the landowner will need to get his money back in as few as ten years; in other cases, perhaps within twenty-five. (Woodland improvements is a special case that will be discussed in Chapter XLVI.)

It is highly important to analyze such improvements from the standpoint of the farm as a whole. On many farms, the drainage of a few small wet spots, the filling in of a gully, or removing a patch of stones, will simplify greatly the problems of planning and cropping systems and reduce fencing costs. Also, a tract of land may well repay improvement costs on one farm and not on another.

[18] See Ch. XXXIII.

In developing farms in new areas, however, types of land should be combined in such a way that lower-grade lands do not need to be improved in order to get enough tillable land in one farm. As it is, many farms in certain areas can produce enough for a family only if additional land is cleared and plowed which were better left in open pastures or woodland. (Chapter XLVI will discuss the possibilities of consolidating such farms into larger units combining farming and forestry, and the possibilities of increasing income through pasture improvement have already been discussed.)

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EXERCISES

1. What have been the changes in cropping systems in your home community in recent years? How are they related to the maintenance of the productivity of the soil?
2. What is the prevailing soil type, or soil series if a soil survey has been made, on your home farm or in your home community? What are its *economic* characteristics, in terms of capacity, efficiency, adaptability, etc.? What factors are most important in determining its value?
3. On this same type of land, what has been the trend in its productivity during the period since it has been farmed? Do you think some level of productivity other than the present one would be more profitable? If so, why, and why do not farmers attain it?
4. On this same land, what and how serious are the problems of erosion? How can they be dealt with physically? If there are alternative ways, which will pay best?
5. If there are serious soil erosion problems on this land, what changes in farm organization as a whole are required if the strictly soil conserving practices are to be most effective?
6. From an individual point of view, under what circumstances is it wise to lower the productivity level of a farm?

CHAPTER XXVIII

Planning the Farm

We have analyzed the special problems of the management of land, labor, equipment, and buildings. We now need to consider all of these combined into complete unified farm plans. Such plans have two closely related aspects. One is planning what we have been calling the farm organization, that is, choosing what to produce and what to use in producing it. The other is planning the physical layout of the fields and of the farmstead and buildings. Our chapters thus far have dealt more largely with the first than with the second of these. This chapter will reverse the emphasis somewhat, but above all it will weave these two aspects together.

The nature of the job of planning a farm depends upon the circumstances under which the need for it arises. The most common occasion for such planning arises when a farm business needs to be replanned. Such replanning can go so far as redesigning the farm completely, including moving the farmstead to another part of the farm and laying it out anew and erecting new farm buildings. Ordinarily, it takes the location of the farmstead as given and devotes itself mainly to changing the size and shape of the fields and the accompanying crop and livestock systems.

But opportunities to plan wholly new farms still arise from time to time; for example, when a farmer buys enough land out of another farm to make a new farm, or when a large farm is broken into smaller farms, or conversely, a large farm is assembled out of smaller ones. The most frequent occasion arises as the result of reclamation of land by drainage, irrigation, or clearing. (The planning of farms in the Columbia Basin Irrigation project will be discussed in the chapter following.)

Any one or more of the following circumstances may create a need for replanning a farm:

1. The farm was not planned right in the first place. Very many of the farms in the United States never really have been consciously planned. They attained their present layout by hit-or-miss evolution.

2. Depreciation of the soil from overcropping or erosion has proceeded so far that the farm needs to be made over into a type that will rehabilitate and conserve the land. This may call for converting some of the present cropland to pasture or hay land, or introducing contour tillage, or strip-cropping or terracing.
3. The adoption of tractors and other power machines may call for larger fields.
4. The type of farming may need to change because of shifts in the demand for farm products and accompanying changes in relative prices. Thus, the opening of the prairie lands of the Midwest and beyond forced the Northeast to change from grain to livestock farming after 1830. Later westward movements similarly affected much of the land in the Great Lakes states after the Civil War.
5. New technologies such as the use of phosphate and lime may call for shifting types of farming toward clover and deep-rooted legumes and keeping more livestock. The cotton picker may shift considerable former cotton land to general farming.

Farms are not usually replanned as soon as they should be. The tendency is for farmers to continue with their old plans until ten or fifteen years after they begin to need replanning. One reason for this is wanting to make sure that the changes are really going to be needed. Farm plans ordinarily must look at least fifteen or twenty years into the future, and some revisions must look thirty to fifty years ahead. But ten years is too long to take to decide upon a change. If farming is going to prosper, farm operators must keep on the alert and be ready at the right time to make up their minds as quickly as possible that their farm businesses and their farm layouts need to be revised. At least, this is true for the younger farmers. Those past fifty-five cannot be expected to make many changes.

Closely associated with the physical planning of farms are the various types of land improvements discussed in Chapter XXVII. Draining the wet spots on a farm or removing stone fences may make it possible to lay it out in large well-shaped fields.

REPLANNING A MIDWEST HOG–DAIRY FARM

The analysis of farm planning from this point on will be presented mostly in terms of individual farms selected so as to bring out the different facets of the problem. The first of these farms has a simple layout, and the planning decisions relate more to replanning the farm business than to the physical layout. Insofar as they have to do with the farm business

as such, the procedures are those which were outlined in Chapters VII to XV, that is, budget analysis to determine the best organization. What follows of this nature is, therefore, little more than a résumé of procedures already explained. Such a résumé is needed, however, in order to integrate the two phases of the farm planning process.

The first farm used as an example is a hog-dairy farm in extreme northern Illinois, in the territory where the timbered lands of southern Wisconsin are gradually giving way to the prairie soils of the Corn Belt. The physical planning of this farm is relatively simple because all the land can be put into one crop rotation except some rolling upland at the back that needs to be kept in permanent pasture or woods.

The basic information required for any job of farm planning must include first of all a map of the farm such as given in Chart 78. This farm was originally a quarter-section homestead, but forty acres of rolling land were later added at the back to provide permanent pasture. This map shows the layout of the fields and their acreage, the land use and cover, and the soil types. Most maps of farms do not show the soil types. Where such information is available, it should always be included. Most of those maps introduced in this and the following chapter will do so. Such base maps should also show the slopes, any areas that are too stony to cultivate, any poorly drained spots, any watercourses or ditches, and so forth.

The dominant soils on this farm are Carrington. These are typical Corn Belt prairie soils with gently undulating topography, very well suited to the growing of corn, and in the cooler temperatures of these northern latitudes, also well suited to hay and pasture. On intervening flat areas and shallow valleys where drainage was formerly deficient, the Clyde soils appear. Usually these need to be tiled before they can be thrown into general cropping systems. The Clinton soils occur on the higher elevations and sloping lands in the same area. These would erode badly under cultivation, and they are mostly in permanent pasture or trees.

The three-year rotation system followed on this farm is corn–oats–hay (clover and timothy). This makes it possible to lay out the cropland in three large fields of 43 acres each. The small field marked NP is a permanent night pasture for the milking herd. The pasture land at the back is reached by means of a two-rod lane at the left. The boundary line of field C follows roughly the division line between the Clinton and the Carrington soils. In planning this farm, as most others, a compromise must be made between having symmetrical fields and following the soil type boundaries closely. The Clyde soils are better suited to grass

and forage than are the Carrington soils, but to work out a special cropping system for them would require two crop rotations and irregularly shaped fields.

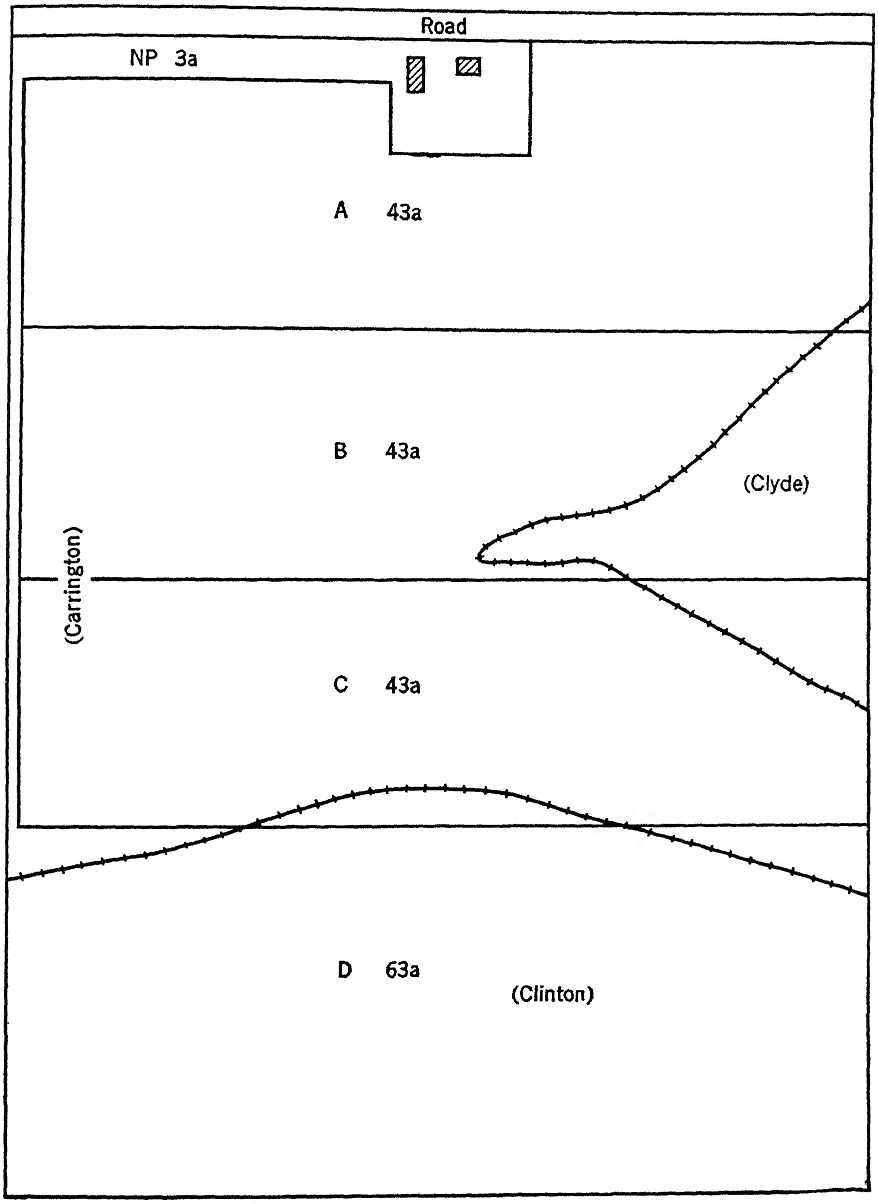

CHART 78. Present plan of a 200-acre farm in Northern Illinois.

The next step is to set down the data on crop production and utilization of feed as given in Tables 66 and 67. The acreage and yield figures in these tables should refer to the average or normal situation when following the present plan. If crop yields above or below average are used, the results will not apply to a run of years.

TABLE 66. PRESENT CROP PRODUCTION AND DISPOSITION

Crop	*Acres*	*Yield per acre*	*Total production*	*Utilization of crops*		
				Seed	*Feed*	*Sale*
Corn, silage	8	9 T.	72 T.		72 T.	
Corn, grain	35	40 bu.	1,400 bu.		1,400 bu.	
Oats	43	32 bu.	1,380 bu.	120 bu.	1,260 bu.	
Clover and timothy hay	43	1¼ T.	54 T.		54 T.	
Permanent pasture	63					
Farmstead and lanes	8					
Total	200					

TABLE 67. LIVESTOCK NUMBERS AND FEED UTILIZATION UNDER PRESENT SYSTEM OF FARMING

Class of livestock	*Number*	*Feed, farm raised*			*Purchased feeds*	
		Corn	*Oats*	*Silage*	*Mixed hay*	*High protein*
Cows	20	220 bu.	400	60	30 T.	1½ T.
Bull	1	7	10	—	2	
Young cattle	12	48	95	12	16	½
Hens	150	70	140			1
Young chickens	300	35	70			½
Hogs raised	86	990	485			½
Horses	3	30	60		6	
Total		1,400	1,260	72	54	4 T.

The amount of feed which goes to the various classes of livestock will need to be estimated, since few farmers keep records of the amount of feed fed each group of animals. Checking the estimates against the total feed available serves to verify them.

TABLE 68. ESTIMATED LIVESTOCK AND LIVESTOCK PRODUCT SALES UNDER THE PRESENT SYSTEM

Product	*Home use*	*For sale*	*Price*	*Total value*
Milk (cwt.)	100	1,000	$1.40 cwt.	$1,400
Cull cows		5	40.00	200
Veal calves		12	12.00	144
Eggs (doz.)	180	1,020	.20	204
Poultry (lbs.)	100	600	.16	96
Hogs (cwt.)	5	191	7 00	1,336
Total				$3,380

The data on receipts and expenditures in Tables 68 and 69 are needed before any actual budgets are set up. For planning farm organizations and farm layouts, the prices used should ordinarily be those which are most likely to prevail in the next ten years or so, unless special circumstances call for either a shorter or a longer time-span. The prices for the various products should also be in the relationship to each other that is likely to prevail in the time-span chosen. The average of some previous reasonably normal period is usually the safest guide. This will be the years 1935–1939 in most cases, except as the war or new developments in technology may have initiated some important departures from this standard — changes in prices and wage levels particularly.

The crop, livestock, and feed expenses in Table 69, it is obvious, must also be estimated on the basis of average prices. General farm expenses, such as for machinery, building, and fence upkeep and repairs, are not listed, since they will remain approximately the same regardless of changes made in the crop and livestock program. This farm is operated by a father and son who do all the work required with the help of exchange labor at threshing and silo filling. Power is furnished by a two-plow general-purpose tractor and three horses. A grain binder, corn binder, milking machine, and a part interest in a silage cutter are the more important special farm machines owned by this farmer.

CROPPING SYSTEM AND FARM-LAYOUT CHANGES A half dozen or so of changes in this farm business could be introduced that would not call for any change in the farm layout. For example, more grain might be fed to the cows and less to hogs; or the farm might shift from selling cream to selling whole milk. The cropping system could even be altered somewhat without changing the farm layout; for example, 20 acres of

TABLE 69. CROP AND LIVESTOCK EXPENSES, PRESENT SYSTEM

Item	*Amount*	*Price per unit*	*Total cost*	
Clover seed	6 bu.	$9.00	$54	
Timothy seed	4 bu.	3.50	14	
Hybrid seed corn	7 bu.	6.00	42	
Threshing	1,380 bu.	.025	34	
Twine	150 lbs.	.12	18	
Silo filling	76 T.	.50	38	
Total crop expense				$200
Veterinary and medicine			$20	
Hog vaccination			36	
High protein feed	4 T.	35.00	140	
Baby chicks	300	.08	24	
Total livestock expense				220

the cropland might be limed and seeded to alfalfa in place of clover and timothy. What we need to discuss here are those changes which also require reworking the farm layout. Such a change would be the one shown in Chart 79, in which the cropland on the farm is divided into five fields of 26 acres each, obviously intended for a five-year rotation system. The system is corn–corn–oats–alfalfa–alfalfa. The production data to go with this are shown in Tables 70 and 71. Ten acres of alfalfa are to be used for hog pasture each year by putting a temporary fence across the end nearest the farmstead of whichever of Fields A, B, or C happens to be in alfalfa that year. The farm is laid out so that with a five-year rotation one of these will always be in alfalfa. The hogs can thus have good alfalfa pasture on clean ground each year. To get this new system established, it is necessary to lime all of the cropland, and also use phosphate and potassium fertilizers.

It is obvious from Tables 70 and 71 that the productivity of the farm is increased. The number of milk cows is increased from 20 to 30, and 4 more young cattle are raised, with the purchase of only two more tons of feed. This is partly because the corn and alfalfa substituted for 17 acres of oats yield more feed per acre than oats. But crop yields are increased also. This latter would not take place at once, of course; at least one full rotation period would pass before the full increase would be realized. The basis for these estimates of increased yields is the experience of other farms in the neighborhood that have followed this five-year rotation system.

Cropping systems can often be changed, of course, without changing the livestock system. In this case, the extra 800 bushels of corn and extra 30 tons of hay could simply be sold for cash. But if the full advantages of improved cropping systems are to be realized, ordinarily the whole

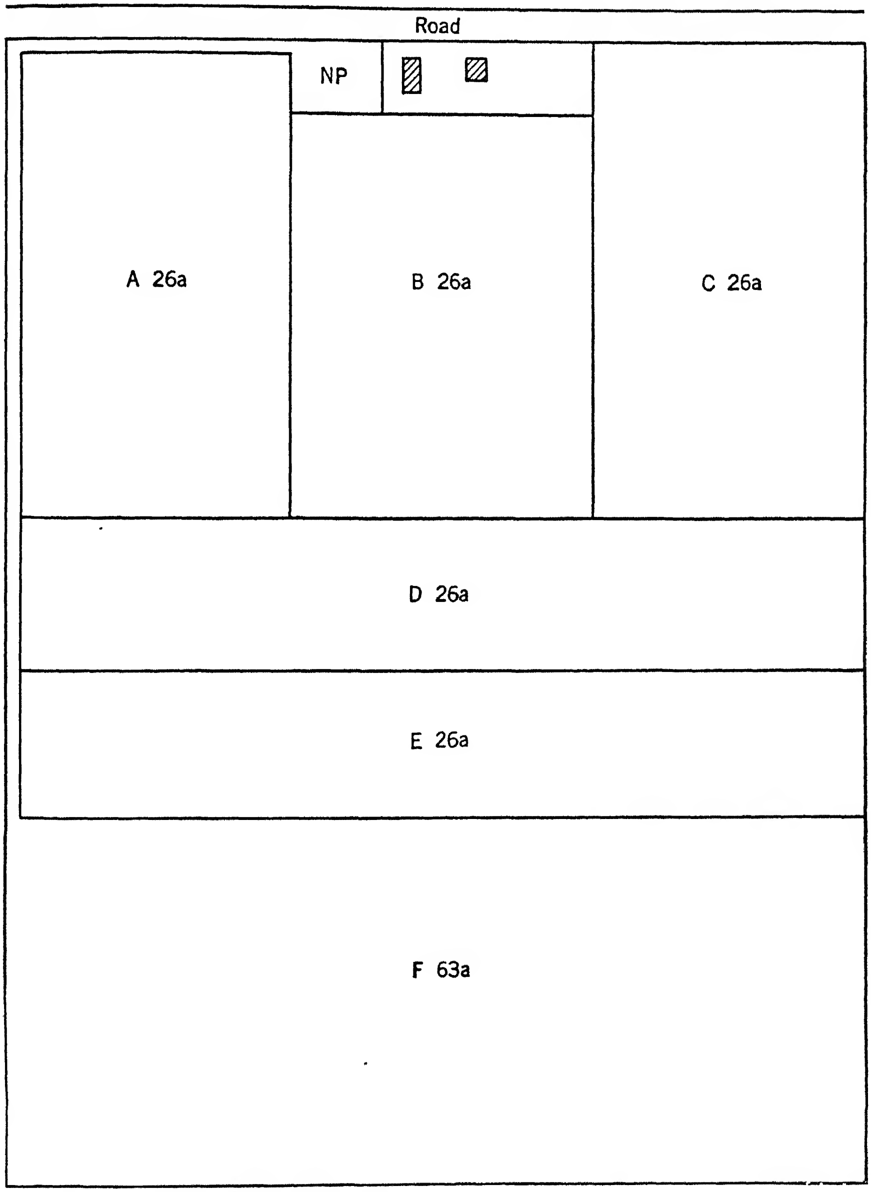

CHART 79. Revised plan for farm shown in Chart 78.

TABLE 70. REVISED CROPPING SYSTEM AND CROP PRODUCTION AND DISPOSITION

Crop	*Acres*	*Yield per acre*	*Total production*	*Utilization of crops*		
				Seed	*Feed*	*Sale*
Corn silage	8	9 T.	72 T.		72 T.	
Corn grain	44	50 bu.	2,200 bu.		2,200 bu.	
Oats	26	40 bu.	1,040 bu.	65 bu.	975 bu.	
Alfalfa hay	42	2 T.	84 T.		84 T.	
Alfalfa hog pasture	10					
Permanent pasture	63					
Farmstead, lanes, etc.	8					
Total	200					

farm business needs to be replanned. That is the reason that the two are being considered together in this chapter. If the extra feed is fed to livestock, this will provide additional manure for the farm and build up yields still further. Nor is it enough merely to feed the extra feed to some kind of livestock. Most of the extra corn, for example, could be fed to hogs, and the alfalfa used to winter more cows and especially young stock. Analysis of the present livestock program showed that the cows are being fed less grain than recommended by dairy husbandmen, and have a rather low milk-production record, and that it would be profitable under the revised plan to feed the present cows and chickens more grain as well as to add more cows and hogs. The revised livestock plan worked out in this way is shown in Table 71. Under the present system, the feed intake, in addition to pasture feed, is 3,540 TDN pounds per cow; under the revised system, it would be 4,000. The substitution of alfalfa for mixed hay would also increase the protein in the ration. Alfalfa would be available for the chickens as well. Available evidence concerning the dairy herd on this farm indicates that it would average 6,560 pounds of milk if fed in the revised way, as compared with 5,500 pounds now.

The revised statement of receipts and expenditures appears in Tables 72 and 73. The same prices are used to estimate the total income under the revised plan as were used in Table 68.[1] At these prices, the farm would have an income from the sale of livestock and livestock products of $4,690 a year with the revised plan in comparison with $3,380 under the present system of farming.

[1] Of course this would not be a reasonable assumption if large numbers of farmers increased their outputs in the same way.

TABLE 71. REVISED LIVESTOCK NUMBERS AND FEED UTILIZATION

Class of livestock	*Number*	*Feed, farm raised*				*Purchased feeds*
		Corn	*Oats*	*Silage*	*Alfalfa*	
Cows	30	450	527	60	60	$2\frac{1}{4}$ T.
Bull	1	7	10	—	2	—
Young cattle	16	64	128	12	16	$\frac{1}{2}$
Hens	150	70	140	—	—	2
Young chickens	300	35	70	—	—	$\frac{1}{2}$
Hogs raised	86	1,544	40			1
Horses	3	30	60	—	6	
Total feed		2,200	975	72	84	$6\frac{1}{4}$ T.

TABLE 72. REVISED LIVESTOCK AND LIVESTOCK PRODUCT SALES

Product	*Amount*		*Price*	*Total value*
	Home use	*Sale*		
Milk (cwt.)	100	1,850	$ 1.40	$2,590
Cull cows	—	6	40.00	240
Veal calves	—	15	12.00	180
Eggs (doz.)	180	1,340	.20	268
Poultry (lbs.)	100	600	.16	96
Hogs (cwt.)	5	188	7.00	1,316
Total value				$4,690

The only changes in the building and machinery would be housing for 10 additional cows and 4 additional young cattle, and fencing for the hogs. The barn can be remodeled by extending the cow stanchions into a section formerly used by horses. There is room in the cattle shed and calf-pen for the additional young cattle. The operator can make these changes with materials now on hand. The milking machine now on the farm can handle the additional cows without difficulty. Substituting a larger acreage of corn and alfalfa for mixed hay increases the work load, in June especially; but the tractor power available will enable the farmer and his grown son to handle the work without hiring extra labor. The only additional cash expenses involved under this revised plan are for feed, fertilizer, gasoline and oil, alfalfa seed, limestone, and temporary hog fence.

TABLE 73. CROP AND LIVESTOCK EXPENSES, REVISED PLAN

Item	*Amount*	*Price per unit*	*Total cost*	
Alfalfa seed	320 lbs.	.35	$112	
Timothy seed	80 lbs.	.07	6	
Hybrid seed corn	9 bu.	6.00	54	
Threshing	1,040 bu.	.025	26	
Twine	90 lbs.	.12	11	
Ground limestone [a]	65 T.	1.50	97	
Fertilizer, 0-18-9	$3\frac{1}{4}$ T.	32.00	104	
Silo filling	72 T.	.50	36	
Total crop expense				$446
Veterinary and medicine			20	
Hog vaccination			36	
High-protein feed	$6\frac{1}{4}$ T.	35.00	220	
Baby chicks	300	.08	24	
Temporary hog fence, waterers, etc., annual cost			30	
Total livestock expense				$330

[a] First five years. After one full rotation, only half as much limestone will be required each year to maintain a desirable pH balance.

After taking into account the increased expenditures required by the revised plan, it will return $3,914, or $954 a year more than the present system. The capital value of the farm will also increase as the soil improves and the buildings are adapted to the new system. The additional expenses involved in the new plan ($356) are so small relative to the increase in physical production that even though fertilizer prices should double, the revised plan is still the more profitable. The farmer and his son will work somewhat harder, but they will be very well rewarded for it.

The foregoing is only one of several possible revisions of the cropping system and physical layout of this farm. Another is to divide the farm into a right section of 60 acres, and a left section of 70, with the lane down the center, and follow a 3-year rotation on the right section, and a 5-year rotation on the left. This would mean 48 acres of corn each year, 34 acres of oats, 28 acres of alfalfa, and 20 acres of clover and timothy. This would give results about midway between the two plans analyzed above, and might be more in keeping with the desires and inclinations of the farmer. Also, perhaps the Clyde soils would be used more in line with their capabilities.

If the farmer insisted on keeping his alfalfa stands four or five years, as many still do, it could be done on this farm by having the same three large fields as in Chart 78, but using a 7-year rotation on A and a 3-year

rotation on B and C. This would mean 25 acres in alfalfa each year, and 29 in other hay, 35 acres in oats, and 41 acres in corn. If this did not provide enough alfalfa, Field A could be enlarged as desired, and B and C contracted.

A farm plan that is to be followed for twenty years or more should not be chosen precipitously. Instead, the operator needs to go to work with the map of his farm, and a pencil and pad of scratch paper, and construct tables like 72 and 73 for all the farm plans that look promising. To do this, he needs to know the yields of corn, oats, alfalfa, clover, and timothy that he can expect on his fields with the different cropping systems. Probably little actual data on these points will be available. If he uses results from experiment station trials, he must recognize that crops and livestock on experiment station farms usually have the right care at the time when needed, and that the results obtained approach the optimum. Under actual farm conditions, the plantings, cultivations, or harvesting may sometimes be delayed for several days. The hay is more likely to be damaged by rain. The cows are less likely to be fed just as they should be. Results from experience on farms in the same area will more nearly fit his actual farm conditions. Therefore, studies made by experiment station workers of such actual experience should also be made available to him. If they are not, he should call upon the county agent to provide him with such information. In order to answer his questions, the county agent may need to make a brief canvass of the experience in his county.

The price information that he needs in order to construct Tables 72 and 73 should be based in part upon experience in his markets, in the period of years chosen as a base, perhaps 1935–1939, and in part on information as to probable trends in prices supplied him by his agricultural extension service. The crux of his price problem is to determine from a study of prices in the recent past the most reasonable price to use in making his farm plan. Care should be taken to avoid giving either extremely high or extremely low prices too much weight.

The starting point in most farm planning, it should now be apparent, is the cropping system which is best suited to conditions in the area and on his particular farm. Even when the crops are fed to livestock, their yield and quality determine the size and kind of livestock program that may be followed with profit. Furthermore, in most areas there is usually one basic crop around which the rotation is built. In Aroostook County, Maine, it is potatoes; in the Corn Belt, it is corn; in much of the Great Plains, it is wheat; in most of the South, it has been cotton or tobacco. Having such a crop to start with simplifies the planning problem greatly.

It is extremely easy to err in making a long-time plan for a farm by not taking into account some factors that are not quickly apparent, or that become evident only when the yields of the crops decline. Most cropping systems and field layouts have to be a compromise between a plan that maximizes the value of crops produced and one that minimizes soil losses. If the farm is rolling and subject to serious erosion losses, a trained soil scientist should, if possible, be asked to inventory the farm from the standpoint of slopes, depth of topsoil, and erosion.

Also, before a liming and fertilizer program is adopted, each field in the farm should be tested to determine how much of the various plant nutrients should be added in the form of lime and fertilizers. Differences in topography, soil structure, and past use all affect the amount of plant nutrients available at any particular time. It is highly probable that different fields on the same farm will require different rates of application. Soil samples can be taken to the county agent's office, or sent to the soils department at the state agricultural college.

Farm planning needs also to take account of such simple mechanical factors as the size and shape of the fields. To fence in completely a 10-acre square field requires 16 rods of fence per acre; a 20-acre field, 11.3 rods; a 40-acre field, 8 rods. A 40-acre field that is 40 rods wide instead of the 80 rods needed to make it square, takes 10 rods per acre; if it is only 20 rods wide, it takes 34 rods. Of course, many of the fields within farms have common boundaries, so that these figures will be reduced considerably in practice. Not only is the cost of fencing involved, but the land occupied by fences and turn-arounds. Size and length of fields are becoming more important because of the increasing use of tractors and large-scale custom outfits. W. J. Spillman's figures indicate that with horse outfits, about 11 per cent of the working time is spent on the turn-arounds with 40-rod rows, and 5 per cent with 100-rod rows.[2]

The shape of the farm and location of the farmstead are important because of their effect on the time spent in getting to and from the fields, and because of the hauling distances. The long narrow farms of Quebec shown in Chart 2 waste considerable time in these ways and have high fencing costs. The ideal shape for a farm is square, like the proverbial quarter-section homestead entry. The hauling distances are least if the farmstead is located at the center of the farm, but this means living off the highway unless the highway bisects the farm, in which case several acres of the farm may be taken for a public road.

[2] *Farm Management*, p. 289.

A SOUTHERN NEW ENGLAND FARM

Let us take, for our next example, a farm which goes well toward the other extreme in the matter of variation in topography, soil, cover, and stoniness. Chart 80 shows the major physical facts about this farm, and its present layout; Chart 81, the proposed layout of its fields. This southern New England farm with 130 acres within its stone fences (called "walls" in New England, and with good reason) now has 48 acres of land in crops, 19 acres of open pasture, 20 acres of brush pasture, 28 acres of woodland pasture, and 8 acres of waste land. Of the hay, 13 acres are of poor quality. Most of the hay is scarcely worth mowing. None of the pasture is rated as first class, P_1, and two thirds of it is rated as third class. This means that much of it has a thin covering of grass, supplanted over much of the surface with low shrubs like sweet fern and blueberry or with haircap moss. Much of what was once open pasture has grown up to birch sprouts, wild cherry, and aspen. This was all cleared land for many years, but the stones were not picked up except on most of Field 18, and only this part of it was ever plowed. Of the 28 acres of woodland, perhaps a third was cleared, but has since reverted to a poor stand of trees. The remainder was all logged a good while ago, and the succeeding growth has been used for family fuel wood, and a little cordwood has been sold at times. The original stand consisted of chestnut, oak, maple, beech, and scattering white pine. The trees now on the woodland mostly range from 20 to 60 years old, and are dominantly oak except for the red maples in the low places. The pasturing has prevented much restocking with young seedlings, so that the stands tend to be somewhat thin over much of the area.

The strongest, most enduring, and most productive soils on the farm are of the Paxton series on the low drumlin facing the farmstead in the opposing corner next to the road. The small strip of Merrimac sandy loam soil in this farm has good location and slope and is also very useful. The dominant Brookfield soils are partly classified in the soil map as loam and partly as stony loam. They produce fair yields, but need liming regularly, and tend to be stony. The Peru soil is less well drained, and the Whitman soils are nearly always too wet for cultivation unless artificially drained. The slopes are mostly under 8 per cent, but a considerable part of the woodland has 12 to 15 per cent slope. Fields 1, 2, and 6 show evidence of moderate sheet erosion, Field 2 being on the sloping sides of the drumlin.

The history of this farm is one of slow gradual deterioration. Enough manure and lime have been applied to the fields still in crops to keep

them in use, but not enough fully to maintain the productivity of the hayfields. Also, a little lime and manure have been spread over the pasture lands nearest the barns and roads. That the applications have not been heavy enough is evidenced by the fact that at present the pastures do not provide summer feed enough for the herd of twenty milk cows, and the operator is buying most of his herd replacements.

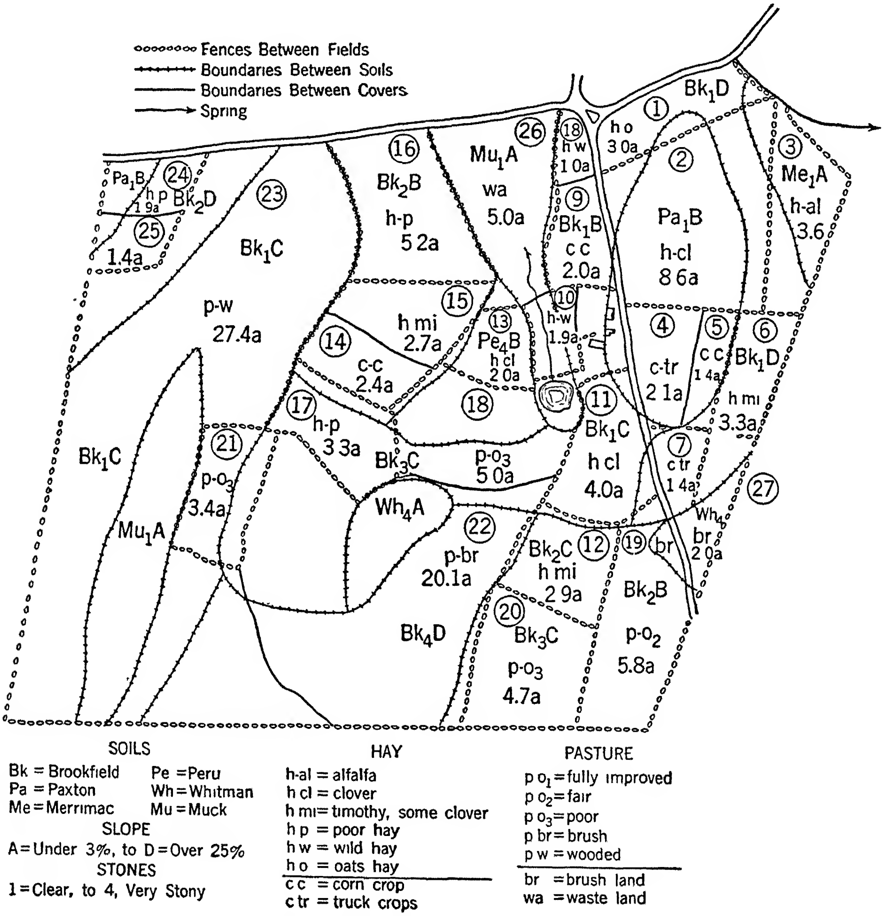

CHART 80. Farm and land-use plan of a southern New England dairy farm.

The farm is near enough to a good market for fluid milk so that it has been possible to buy large amounts of protein concentrates and keep going. The operator's main effort has been devoted to producing enough hay to carry his herd. He has now reached the point of feeding hay during much of the pasture season. The corn and oats are fed as pasture supplements. A further factor in the situation is that the operator has

insisted on growing several acres of truck crops for the city market nearby as a supplementary source of cash income. This has made a heavy demand upon his supply of manure. The present operator's major concession to the preachments of the agricultural extension staff has been the growing of more clover in his hay in the last ten years, and recently he has succeeded with alfalfa. He is a good dairyman, his herd averaging nearly 7,000 pounds of milk per cow. A hired hand is employed the year round.

The replanning of a farm of this sort may be done on various levels of intensity. At one extreme, a major problem may be the stone fences that divide the present and former cropland into 22 different fields mostly from 3 to 5 acres in size. If the farms of New England are going to be tractor-farmed as in much of the Midwest, a mile or two of stone walls may need to be removed. But part of the fields will also be found to have too many stones still in the surface soil for tractor plowing. Possibly methods of using power now developing will make feasible these extreme measures. They might even make practicable the removal of stones and the plowing of some of the pasture land never yet cultivated. A mild form of reorganization might accept the field arrangements as they now are and confine itself to shifts between major uses and the like.

The reorganization presented in Chart 81 is more nearly of the milder sort. The economic situation is not likely to warrant the expansion of output that would accompany a more drastic reorganization. A major feature of this proposed plan is an increase in the pasture feed by converting 8 acres of the best of the present pasture plus 2 acres of present meadow (Fields 10 and 12) to high-quality pasture by seeding it either to ladino clover or to some good pasture grass mixture. The ladino clover furnishes excellent pasture forage after the ordinary grasses have stopped their vigorous spring and early summer growth. This seeding will require plowing and growing a nurse crop of oats cut for hay, preferably with one year of corn or other row crop in between. All of this land, however, has been plowed before, although Field 12 not recently. Liming and heavy fertilization will be needed in the conversion stage. Field 13 is to be improved to the extent of pulling out the sweet fern and applying lime and fertilizer; Field 15 only by liming and fertilizing.

Next in order of importance is improving the meadows. This is to be done by putting all of them into one of two 9-year rotation plans, the A plan including corn, oats, and hay each for a year, the latter serving as a nurse crop for a low-alfalfa seeding consisting of alfalfa, red clover, timothy, and redtop. The fields recommended for this rotation (30 acres)

mostly have B slopes, and can stand one year in nine in row crops. On the C slopes, however, the cropping should be in contour strips. Rotation B, recommended for 18 acres of steeper slopes, substitutes millet for corn, and probably will not require strip-cropping. Liming and fertilization will be needed at the time of reseeding and as top-dressing subsequently. The 3 acres of corn grown in the average year will be fed green as pasture supplement, and probably part of the millet and oats.

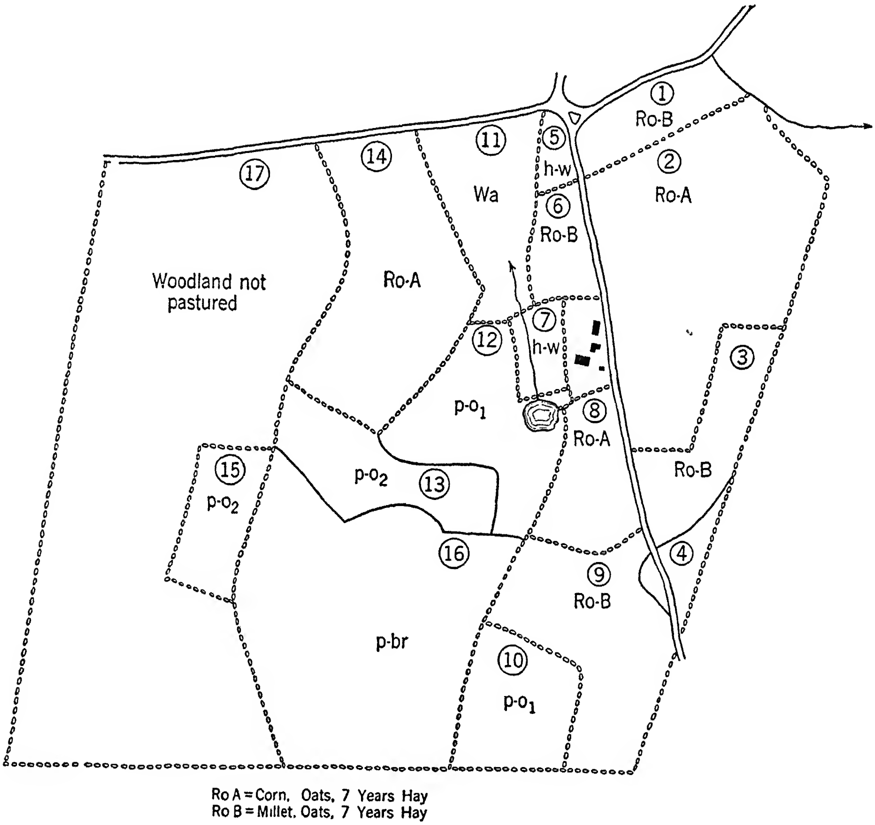

CHART 81. Revised plan for the same farm.

If the operator wishes to continue with his truck crops, some portion of the Rotation-A land can be set aside for this use. But the extra pasture and forage available in the replanned farm should enable him to keep several more milk cows and in addition raise all his replacements. His expenses per animal unit will be reduced because the expenditures for fertilizer will be much less than the saving in feed bills. Both the pasture

feed and the hay have a much higher percentage of protein, and the cost of concentrates will be lessened. There will be work enough on the farm without the truck crops. It will be noted that the fields are considerably enlarged on the new plan, provided a small amount of stone fence is removed. They are still irregular in shape. Some of this difficulty could be remedied by removing still more fence.

The proposal for the woodland (Field 17) is to fence the cattle out of it and to cease the clear-cutting of patches of timber for the annual wood supply, and do "improvement cutting" instead, over the whole area as rapidly as the wood can be used for fuel. This will mean cutting out the damaged and misshapen trees and the large spreading trees that never will yield good saw logs. There will be need also for the weeding out of saplings and sprout clusters of gray birch, pin cherry, and other poor species in the younger stands. The foresters estimate that under such treatment, this woodland will yield, at present prices, at least $3.00 worth of products per acre once it is in full productivity, as compared with only $1.25 per acre if present management is continued.

The 20 acres of brush pasture are to be left alone for the present. With plenty of good pasture feed provided elsewhere, the cattle will use it less, and probably in ten or twenty years some of it can be converted to woodland also.

Should this operator become really ambitious, he could thin out the sprout clusters in Field 4 and gradually allow a fair stand of red maple and oak to establish itself. Field 11 could be drained if the neighbor across the road would join with him in opening a ditch to a little brook shown in the upper right-hand corner; or if the water from the spring feeding the pool in the barnyard could be pumped and used on the farm. If, on the other hand, the proposed plan is too ambitious for the operator, Field 18 can be improved only as proposed for Field 17, and the ladino clover can be seeded in part of Field 14. This will decrease the amount of both pasture and hay available.

In order to decide wisely among these possible reorganizations, the farmer will need to figure out his probable expenses and receipts under each of them, consider the amount of work that will be involved in each, and the investment in improvements. Such figuring indicates that his gross receipts in 1935–1939 under his present plan of operation averaged $3,850, and his cash outlays including wages of his hired man, $2,330, leaving $1,520 as net income, and that the proposed plan would increase his receipts only $340, but would reduce his feed bills by $520 and total expenses by $440, making a total gain of $780. The more drastic plan that includes draining Fields 26, 18, and 10, clearing some

of Field 23 and enlarging Fields 14, 15, and 16, and straightening out their boundaries, and removing stone fences and enlarging the fields across the road, would increase the net farm income by as much more. It would make possible the use of tractor equipment and enable two men to do all the work.

SOIL SURVEYS AND FARM PLANNING

Clearly the facts as to the physical land base of a farm are absolutely essential for its planning. The map used in replanning the New England farm furnished much more information than the one used for the Illinois farm. It was a special map made by a soil surveyor with the help of a farm management specialist. The Illinois map was mostly based on a county soil survey made a long while ago. General soil surveys can scarcely give all of the detail shown in Chart 80 without making them too costly. Still, all the information given in Chart 80 is needed if the farm is to be thoroughly well planned. Although the early soil surveys were projected with the idea in mind that they would contribute in an important measure directly to the management of the land surveyed, even including the management of individual farms, it has become apparent that by themselves they will not suffice in areas with such varied landscapes as those of New England. An 80-acre farm, occupying an area of one eighth of a square inch on the county soils map, may show several soil types on the map; but ordinarily it shows only one or two. If these same farms could be mapped upon a scale of four inches to the mile, anywhere from three or four to ten soil types would be more likely to appear anywhere in glaciated or dissected territory. A small farm of 20 acres may be all of another type than that shown on the usual county soil map.[3]

Also, most of the soil survey reports now available do not go far enough in indicating the management needed for different types and conditions of land. The usual report devotes many pages to stating in general terms the uses to which soil types are put, distinguishing between the major uses as forests, pasture, hay land, and cultivated crops and also between different crops. They also commonly describe the principal rotations and other practices, including the use of fertilizers and lime. One finds, however, in the usual report few statements as to what the better practices are on the various soil types. For effective farm planning, one needs to know the results obtained from different treatments and practices, different rates of applications of lime and fertilizer, and dif-

[3] A square inch on the county survey maps represents 640 acres.

ferent rotations. The maps in these survey reports, nevertheless, can be of much use in farm planning. They show what soil types are found in the area in general, and describe them and their occurrence in such a way that a little study of them will enable many farm operators to determine the principal types on their farms and their approximate boundaries. They can then fill in the details as to slope, stoniness, and cover from their knowledge of their own farms. A small amount of help from the agricultural extension service, or representatives of the Soil Conservation Service, may serve for the rest.

In recent years, the soil survey reports have included more and more information about land management.[4] At present, the amount which they contain is limited only by the research which has been done. Experiment station research has not shown us enough that we need to know about the management of particular soils. It has tended to take the form of making soil surveys first, and the analysis of management afterwards; and funds have not been available for both. When the experiment stations get the second kind of research done, the farm planners will be able to take maps showing the principal soils of an area, and the results of experiments on the effects of different practices with different crops and rotations on these soils, and put the two together into sound programs of land management. The specialists working with the farmers will soon learn to recognize the soil types and how to handle them, as will also the farmers with a little agricultural training. The writer has observed with great interest on several occasions recently how quickly the information of new soil surveys has come into common use at meetings held in the county and into the conversation between county agent and farmer.

LAND CLASSIFICATION

Within the past ten years, a number of the states, and several public agencies, have developed systems of land classification designed to provide information that can be used directly in farm planning. These commonly take the form of classifying land according to its quality and best use. Several different systems of numbering are followed, but the land is usually classified under four or more heads, which we shall here designate as A, B, C, D, etc. Class A in such an analysis may include the relatively level land with good soils that can be farmed in short

[4] To show the progress made in recent years, one can compare the soils survey for Hampton and Hampshire Counties, Massachusetts, made in 1928 with that made for Grafton County, New Hampshire in 1935; or the still more recent report for Calloway County, Kentucky.

rotations; Class B, that which can safely be plowed but only at longer intervals, and hence should be farmed in long rotations; Class C, hill lands or stony lands that should not be plowed at all, but kept in permanent pasture; Class D, land too rough or stony or poor to be used even for pasture, and hence kept in timber. Class E might refer to land too wet to be plowed and kept in hay or pasture. These classes may be subdivided; for example, Class C land may be subdivided into hilly land and stony land.[5]

The most extensively used land classification system in this country now is that of the Soil Conservation Service into "land capability classes." This classification places more emphasis on exposure to erosion and erosion control and less on productivity than the others. It divides the land in arable regions into Classes 1 to 5, and in grazing regions into Classes 6 to 9. The arable classes are as follows: [6]

1. Suitable for cultivation without special practices.
2. Suitable for cultivation with simple practices.
3. Suitable for cultivation with complex or intensive practices.
4. Not suitable for continuous cultivation.
5. Not suitable for cultivation.

Land in Class 1 must be tillable, at least moderately productive, very nearly level, and not significantly damaged by erosion. It can be used for any crop for which it is suited as long as its plant nutrients are replenished and good soil structure is maintained. On land in Class 2, simple practices of some kind are necessary to control erosion. The practices required may be illustrated by Winona County, Minnesota, where the Soil Conservation specifies a 5-year rotation that includes 3 years of hay, or a system of contour strips or terraces if a shorter rotation is used.[7] Land of Class 3 requires complex or intensive practices, or very careful application of some practice, for regular cultivation or for any similar degree of utilization; in Winona County, for example, contour stripping with a 5-year rotation that includes hay 4 years, or terracing with a 4-year rotation that includes hay 2 years. Class 4 consists of land that is not suitable for continuous or regular cultivation, but safe for some uses that involve short periods of cultivation. Much

[5] The use of the recent soil survey reports as a basis for land classification is illustrated by the report for Calloway County cited previously. Also see U.S.D.A. Tech. Bull. 46a, 1935.

[6] See E. A. Norton, *Soil Conservation Handbook*, U.S.D.A. Misc. Pub. 352, 1939, for a fuller description of these classes. And see Mark H. Brown and Iver J. Nygard,* *Erosion and Related Land Use Conditions in Winona County, Minnesota*, U.S.D.A., Erosion Survey No. 17, for an example of the application of these classes.

[7] *Handbook*, p. 20.

of the land classified as 4 has been affected by sheet erosion and gullying. Land in Class 5 is unsuitable, because of steep slopes, unproductive soils, or some other reason, for any type of utilization that involves tillage.

Grazing lands are classified by the S C S into four classes as follows:

6. Land that can be utilized effectively for permanent grazing without the practice of special measures to control soil erosion or to correct other unfavorable conditions.
7. Land that can be permanently grazed through the use of good range management and measures to conserve rainfall and control soil erosion or to correct other unfavorable conditions.
8. Land that can be used effectively for permanent grazing under very strict range management.
9. Land that cannot be utilized effectively for grazing, such as barren tracts and inaccessibly steep areas.

How the S C S classification is used is illustrated in Chapter XXIX. Such classifications can be highly useful if no soil map is available for the farm or the county, and are a valuable supplement to a county soil survey map. They are of some use as a supplement to a detailed soil map for an individual farm, but they do not take the place of such a detailed map. An expenditure of $50 on getting a good farm map, like Chart 80 except on a much larger scale, will usually repay itself in a few years.

The principal shortcoming of all land-class maps is that they tend to introduce too much inflexibility into farm planning. They should never be followed rigidly. The actual plan for any farm needs to take account of the special conditions on that farm. A farm with an abundance of level land, like the one shown in Chart 78, can keep all of Field D in pasture. But if half of the farm were on the hill at the back end of the farm, the farm plan might provide for growing crops halfway up its slope, making use of strip-cropping, or even terracing; or it might provide for a long rotation system in which the slope would be kept in alfalfa much of the time, and in broadcast crops the rest of the time. Similarly, the farm shown in Chart 80 has a wide range of possible uses of its different fields. It could be made into a one-man farm or a two-man farm, or even more, according to how much of the land is put in the Rotations A and B, or into Rotation A as distinguished from B. The time-span for which the planning is done is highly important in such cases. A plan that would be advantageous over ten years with a relatively short rotation on moderate slopes might prove disastrous in twenty-five years.

Actual farm plans may also be limited by the buildings now on the farm. These can be enlarged or supplemented, it is true, but this takes capital, and many farmers now have all the debt they can safely carry. On many hundreds of thousands of dairy farms in this country, the barn room is now setting the upper limit upon the number of cows milked. On others, it is the amount of family labor available to help with the milking or the field work during the planting or harvesting season. Also, in many cases, the farm operations have to be fitted more or less to the capacity of either one or two hired laborers by the year or season. The amount of land planted to certain labor-intensive crops is likely to be planned to provide about the amount of work that a particular labor force can handle. Finally, the amount of a particular product that can be disposed of at a good price in a local market may be a highly limiting factor. Third, the amount of vegetables or small fruit that can be disposed of in local markets during the local season commonly sets a limit on the acreage of such crops. Whether quick freezing of local fruits and vegetables will change this situation in the future can only be conjectured at this time.

EXERCISES

1. Work up a brief farm plan for your home farm or one with which you are familiar showing: (a) farm layout; (b) soil area boundaries; (c) tables like 66 to 69 in this chapter.
2. Prepare an alternative plan for this farm indicating net advantages and disadvantages.
3. What types of information needed for such replanning are most lacking? How can the information be best provided?

CHAPTER XXIX

Planning the Farm

— continued

THIS CHAPTER WILL EXAMINE THE FARM PLANNING NOW BEING DONE in several of the states and by several public agencies, in order to reveal the problems involved in different situations.

FARM PLANNING BY THE STATES

Several of the states, in the years just before the war, issued excellent guides and instructions to the farmers of their states for replanning their farm businesses. These called for maps of their farms, the A A A maps being used as a foundation. The A A A maps do not include soil types, contour lines, or slopes, but these can be added if the information is available. The guides also provide for budgeting farm receipts and expenditures, and balancing feed and livestock under the present and proposed plans, and include tables of useful information, such as average prices in the past five or ten years for the different products, average inputs or requirements, and the like. The most complete of these guides are those for Illinois, Michigan, and Missouri.[1]

An excellent use of the personnel resources of these and other states would be to help a considerable number of farmers to make these plans and to keep the kind of individual farm records described in Chapter XXIII, and then to help these farmers analyze their records in such a way as to guide them in their year-by-year budgeting and future revisions of their plans. The records of these farms can be

[1] C. O. May, *Analyzing and Planning the Farm Business*, Extension Service, Michigan State College.

D. B. Ibach, *Re-planning Missouri Farms*, Missouri Circular 375, 1938.

P. A. Eke, *Planning the Farm Business for the Year Ahead*, Idaho Bull. 188, 1941.

Division of Farm Management, *Taking Inventory and Planning the Farm Business for Next Year*, Indiana Bull. 229, 1940.

H. C. Holmes, *Planning the Farm Layout and Cropping System*, Tennessee Publication 245, 1940.

S. B. Cleland and W. A. Peters, *Farm Planning*, Minnesota Pamphlets 43–50, 1940.

summarized in such a way that they will furnish data that can be used on similar farms. Much of the research of the experiment stations could advantageously be pointed directly toward supplying these and other farmers with the information needed in making such plans.

Several of the states have also published reports of farm replanning activities. Chart 82 shows "before" and "after" plans and an intermediate stage, for a farm in Freeborn County, Minnesota. In 1931 when the present owner bought it, 43 per cent of the land produced little income because it was partly wooded or poorly drained. The fields were irregular in shape and size. One may ask how this farm ever acquired such a layout. The explanation is partly that the wet land always stood in the way of its symmetrical development. But the process by which the land was cleared had much to do with it also. The cutting of the timber was seldom planned with a view to making regular-shaped fields. Usually the stump lands were pastured and then cleared in patches where the stumps had rotted most. The plan shows the important part that tile drainage plays in the reorganization. This farm was scheduled to take ten years in changing from the old to the new plan.

Another farm planned in this Minnesota report is a cut-over farm in St. Louis County, at the northern end of the state, with 80 acres of tilled land and open pasture, and the rest largely in burned-over brush and timber. It is converted into 80 acres of tilled land in fairly regular fields, 60 acres of open pasture, and 20 acres of woodland and farmstead. The replanning of farms in the less timbered parts of Minnesota mostly takes the form of fitting fields and rotation systems together. No budget analysis accompanies any of these revised plans; it is simply assumed that any changes that improve a farm physically will increase its earning power.

The planning of eight farms in Union County in northeastern Florida is presented as mainly a problem of fitting cropping systems, with some timber and pasture, to the rather mixed soil patterns found on these farms without making too many irregularly shaped fields.[2] The soil textures range only from fine sand to loamy fine sand to fine sandy loam, but the series vary considerably in quality. Nearly all the soils are suited to such truck crops as beans, watermelons, and cucumbers. The fall crops are corn, velvet beans, and peanuts, with Austrian peas as a winter cover crop; and some of the soils are suited to either bright tobacco or to sea island cotton. The lower lands produce fair pasture combined

[2] D. G. Miley, *Land Use Plans for 8 Union County Farms*, University of Florida, March, 1939.

with thin stands of pine or oak. In general, the tilled land is cropped one year, often double-cropped, and then allowed to rest the next. Crotolaria is often recommended as a cover crop in this resting year, but agronomists are inclined to believe that the native beggarweed that seeds itself is more satisfactory on the loamier soils. Keeping half the land out of production each year is more of a sacrifice of present income than most small farmers can afford. Yet if they do not follow the practice, their land in ten years or so will not "make a crop of peanuts."

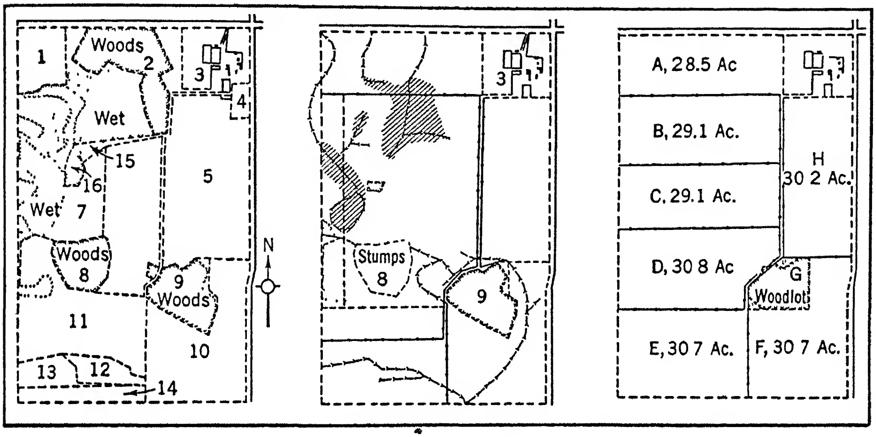

CHART 82. Original and revised plans in three stages, of a farm in Freeborn County, Minnesota. (O. W. Howe, *Planning the Physical Layout of Farms*, Minnesota Bull. 350, 1940.)

No budgets are presented for these eight farms. The planners believe, however, that the revised plans will increase the farm income over a span of ten years or so.

S C S FARM PLANNING [3]

All of the agreements between the S C S and individual farmers on its demonstration projects, and between 320,000 individual farmers and 1,460 soil conservation districts to the end of 1945, include a "farm conservation plan." The plans now drawn take the form of a map of the farm showing the land-use and land-capability classes, like Chart 83, and a second map, like Chart 84, showing the completed plan, and a program of the conservation operations which specifies what the farmer

[3] The maps and information in this section were furnished by the Regional Project Plans Division of the Spartansburg Regional Office of the S C S, under instruction from M. H. Cohee, then head of this Division of the S C S.

agrees to do and what the district agrees to do. This farm had 93 acres of cropland in 1935 and also in 1944 after the program was completed. It is in the South Carolina piedmont, in an area where cotton and peaches are the principal earners of income. It has two cropper families resident on the farm, who in 1944 were tending to 22 of the 25 acres of cotton.

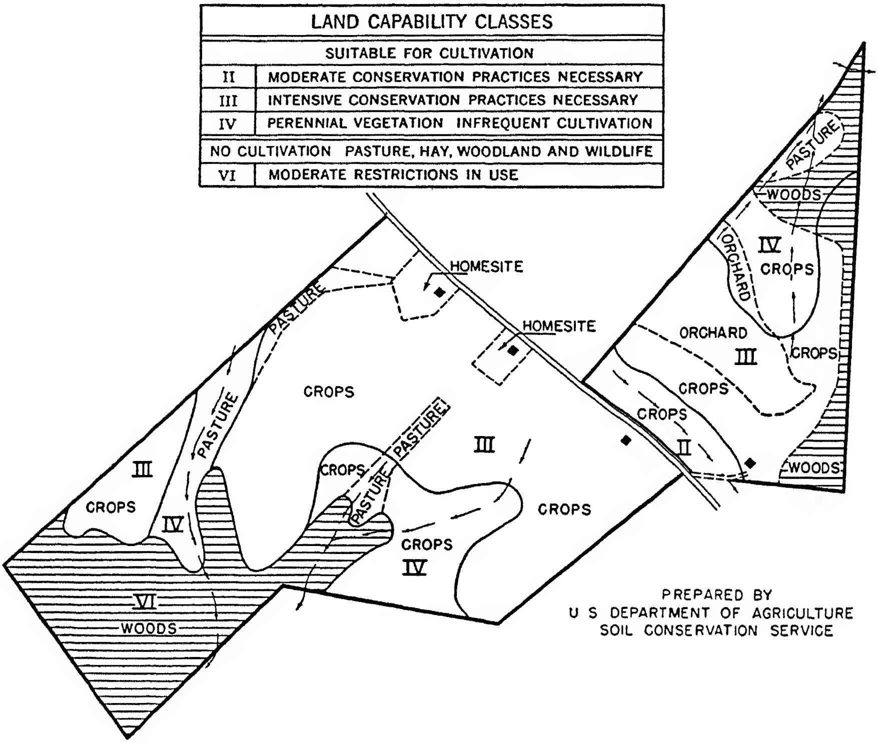

CHART 83. Land-use and land-capability classes on a farm in Greenville County, South Carolina, in 1935.

In 1935, the livestock receipts were 17 per cent of the total; in 1944, they were 25 per cent. In 1935, the farm had 6 head of cattle and 2 sows; in 1944, it had 18 head of dairy cattle, 5 head of beef cattle, and 3 sows. The 1944 cropping program included 10 acres less of cotton and 7 acres less of corn, and 4 more acres of small grains, 4 acres of kudzu, and 5 acres of lespedeza sericea in wild-life borders and meadow-strips. It also increased the peach orchard from 5 to 9 acres. In addition, lespedeza hay and seed was substituted for cowpea hay and seed, and the double-cropped acreage was increased from 12 to 20. The reduction in cotton and corn acreage was offset by larger yields and by the shift toward

No budget statements accompany this plan. Very little budgeting analysis is done. The conservationists instead follow certain guiding principles which they believe have been demonstrated by experience to be right. These principles assign major importance to the control of erosion and to the physical bases of productivity. They expect the practical-mindedness of the farmers, who must approve the programs, to keep them in line with economic realities.

F S A FARM PLANNING ON TENANT-PURCHASE FARMS[4]

The Farm Ownership branch of the F S A by the end of 1945 had assisted 49,000 families, mostly tenants, in becoming owners of farms, and had prepared a farm plan for each of the farms. Frequently, rather extensive farm improvements are involved. Chart 84 shows the "before" and "after" farm plans for a farm of 107 acres in Titus County in extreme northeastern Texas. At the start, it had 59 acres in crops in the two big fields. They were in badly run-down condition, the cotton yielding around 125 pounds lint; the corn, 14 bushels; and the peanuts, 12 bushels. The only pasture was in the brush and woodland tract in the center. Almost all the cash income was from cotton, only 3 cows being kept. In its present replanned form, only 42 acres are in crops, but these are ridge-terraced and strip-cropped in a rotation including cotton, corn, sorghum, and peanuts, with winter vetch and cowpeas being plowed under on part of the cropland each year. The nineteen terrace outlets have been sodded with Bermuda grass. The meadow in Field 1 has been improved by applying phosphate and seeding in lespedeza. A major emphasis is placed on pasture improvement. This farm is already supporting 10 Jersey cows and 16 head of young stock. Brush and trees have been removed from much of the woodland and the sprouts and weeds are mowed once or twice a year. Lespedeza and Bermuda have been established on 12 acres. Phosphate has been applied to much of the pasture, and the grazing has been controlled to insure survival of the young pasture plants. Farm ponds have been built in each of the pastures. The 41 acres of pasture in Field 5 supported 20 animal units in 1945. The yields of most of the crops had doubled by 1945. Progress has been rapid in part because credit has been advanced to cover the capital investments required.

The changes on a 110-acre farm in Mayes County, in northeastern Oklahoma, were of the same general order except that an oats–corn–

[4] The plans for this farm were supplied by the county F S A supervisor under instructions from L. H. Hauter, Special Assistant to the F S A Administrator.

sorghum rotation was substituted for a wheat–cotton combination, the pasture mixture was lespedeza and rye grass and the poultry enterprise was expanded as well as the dairy.

The drastic reorganizations sometimes planned on tenant-purchase farms are illustrated by a 207-acre farm in Lawrence County in southeastern Missouri. The farm had practiced a crop-and-livestock system

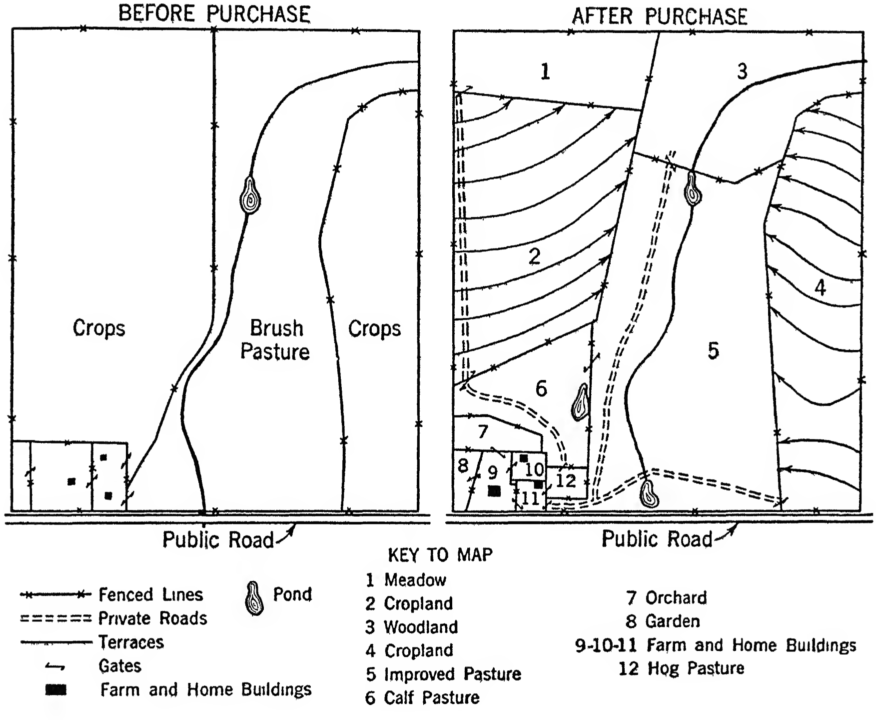

CHART 85. Farm plan before purchase in 1940 and as planned under the Tenant-Purchase program, 107-acre farm in Titus County, Texas.

of farming with emphasis on the cash crops, soybeans and wheat. A large 100-acre permanent pasture supported only 8 cows and 60 ewes. The farm was running down gradually. The revised plan includes no corn, wheat, or soybeans, but is based on raising forage for livestock — alfalfa, sweet clover, and a mixture of orchard grass and lespedeza for hay. The pasture is mainly of this same mixture, and is renewed every few years. The receipts of $5,000 in 1944 were a third from beef cattle, a sixth each from dairy products, lambs and wool, and orchard-grass seed, and a tenth from poultry. The income has already been increased considerably and the farm is improving rapidly.

The replanning of an 87-acre farm in Belmont County, in the hilly section of southeastern Ohio, took the form of ridge-terracing and strip-rotating the sloping fields, and expanding and improving the dairy herd and poultry flock; that of a 132-acre farm in Pulaski County in south central Kentucky, and also of a 156-acre farm in north central North Carolina, mainly the form of clearing out the brush and rehabilitating some badly run-down pastures and fields. These two farms had been operated for the preceding ten years or so by farmers old enough to retire.

These six farms provide a good exhibit of the types of farm planning that the Farm Ownership program is called upon to do. The planning for livestock production is fully as important as planning the land use and land improvements. If these plans are to prove successful, they need to be based on analysis of the various alternatives, especially when major changes are being considered. Not all of the tenant-purchase plans are analyzed as carefully as needed. This lack, combined with misjudging of prospective purchasers, has led to the failure of at least one tenth of the purchases since the program was started in 1938.

PLANNING T V A TEST-DEMONSTRATION FARMS [5]

The approach to farm planning in the test-demonstration farms in the Tennessee Valley region is clearly different from that outlined in Chapter XXVIII, and from that followed on the tenant-purchase farms. Early in the program on some farms, the planning the first year went little farther than to choose the fields upon which to apply the lime and phosphate. The objective the first year was mainly to show the farmer how the lime and fertilizers would increase plant growth. The next step has been to work out a five-year crop and pasture program with the farmer. This has indicated which fields were to be planted to each crop in each of these years and what the lime and fertilizer applications were to be. Presently, however, many of the farmers did not need this demonstration at the outset, for they had observed the effects of the program on neighboring farms, and the five-year cropping plans were made at the start. The statements accompanying these plans, which were worked out in close consultation with the farmer, were also likely to contain some suggestions relative to the livestock program. The cropping plans may

[5] The reports in this section on four test-demonstration farms are based on information assembled by Hugh A. Powers of the Division of Agricultural Relations of the T V A, with the assistance of the agricultural extension staff members operating in the counties.

of course be revised more or less from year to year. This procedure has involved looking at the farm as a whole, but no careful budgeting of alternatives. In the summer of 1946, however, the farm planning on new test-demonstration farms in Tennessee began to take the form of projecting from the start the crop and livestock program that would maximize incomes.

Chart 86, based on the procedures followed in the past, compares the farm plan as it was in 1935 before the farmer became a test-demonstration farmer, with the farm plan as it had evolved at some later date. The only major change in land use on this Russell County farm in southeastern Virginia is that one west field is shifted from pasture to crops, and in exchange most of three north fields are shifted from crops to pasture. The detailed soil map available for this farm shows that this is a definite improvement. Phosphate has been applied liberally to the pasture and hay crops. Most of the real farms in Russell County are larger than this one, and depend upon beef cattle, sheep, and grazing combined with burley tobacco. This farmer has shifted to dairying as a means of obtaining a sufficient income from a small acreage. The fertilizer and manure have increased his crop yields, and he has improved his herd. He gets large tonnages of ensilage per acre, and already has a little alfalfa and intends to grow more.

A farm in Buncombe County in western North Carolina presents a very different type of problem. It had become badly eroded and gullied, and the pasture had grown up to brush and weeds, as a result of years of continuous cropping. The erosion has been checked and the productivity of the land increased to a point where the farm in 1944 was carrying 36 head of beef cattle compared with 16 in 1939, as a result of a program consisting at the start of subsoiling to enable the soil to hold more water, applying lime and phosphate, and seeding to grass and legumes. The pastures have been seeded to a mixture of orchard grass and lespedeza mainly. The cropping system includes corn, oats, and two years of clover and grass hay in strips laid out on the contour, with 4 acres of tobacco in a separate rotation with corn and clover on three small level fields. A plan was made for the first year's operation, and this was revised each year.

Both this farm and another in the same county have had long-time farm woodland plans developed, which will be discussed in Chapter XLVII.

The farm plan in Chart 87 shows the land use and cropping system of a 135-acre farm in Blount County on the eastern side of the Eastern Limestone Valleys of Tennessee. This farm typifies the highly diversified

general farming practiced in this area. This farm in 1943 sold wheat and tobacco as cash crops, hogs, beef cattle, eggs, and milk and butter. The detailed soil map of this farm shows a complex pattern weaving together Montevallo soils derived from acid shales, and Dewey soils derived from dolomitic limestone, and a little poorly drained bottom land along two very small streams that traverse this farm in two direc-

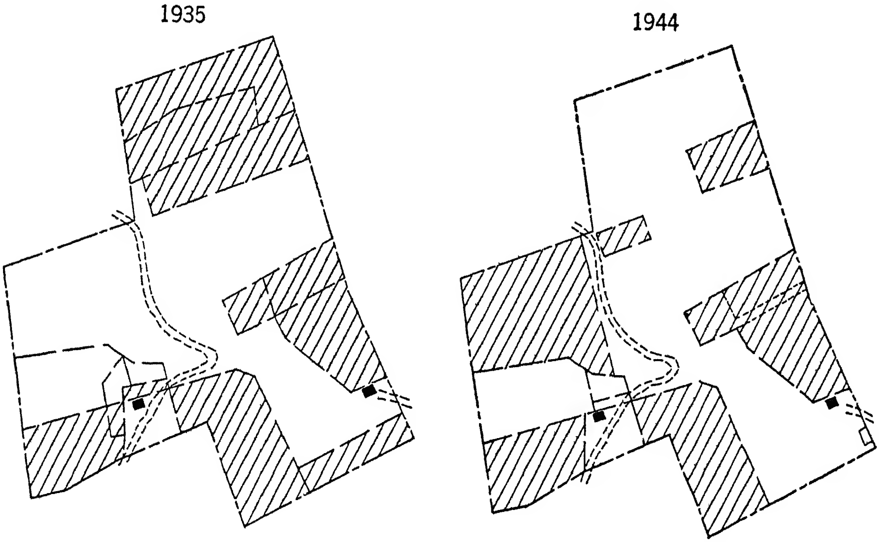

CHART 86. Plan of test-demonstration farm in Russell County, Virginia, in 1935, and in 1944.

tions. The major portion of this farm is Montevallo silt loam, ranging from eroded to severely eroded, to rough and gullied. The field layout changed scarcely at all in the eight years after 1935 when this farm became a test-demonstration farm — it is pretty well determined by the slopes — but terraces were built in three of the fields, and erosion has been pretty well checked by contour cultivation and by getting closer-growing stands of grass and hay through liming and phosphating and reseeding. The cropping system in 1943 differed from that in 1935 only in that it included 3 acres of alfalfa and more double-cropping with lespedeza. The 1943 farm receipts were 28 per cent from wheat and tobacco, as compared with 9 per cent in 1935 — probably the effect of the high wartime prices of these products. The farm was carrying about the same livestock in 1943 as in 1935.

The change in the farm plan for an 84-acre farm in Hancock County, Tennessee, at the northern end of the Eastern Valleys, consisted of block-

ing off a large 35-acre field of the least sloping and least eroding of the land and strip-cropping this completely. This puts less land in corn, but the yields have been increased enough to more than offset the reduced acres. Cash crops were only a third of the farm receipts in 1942 compared with two thirds at the start. The farm is carrying 8 milk cows now instead of 4 at the start.

These reports of improvements in land use and farm organization do not, of course, include the gains in family living from having electricity available for use in the homes.

Around 30,000 test-demonstration farms are now being handled in this way, and prospects are for a large postwar extension of this program. It is highly important, therefore, that the planning methods be made as effective as possible. In 1940–1941, the Tennessee Agricultural Extension Service in collaboration with the T V A, as a check on the more or less year-to-year farm planning done by the Assistant County Agents, used the methods outlined in Chapter XXVIII on a carefully sampled group of fifty farms in the Eastern Valley of Tennessee. Budget analyses were made of alternative cropping, land use, and livestock programs, and an optimum plan and program laid out for each of these farms.[6] These optimum plans were conservative; thus they used the increases in yields that are likely to take place on the average farms rather than those reported for experiment station trials. The current plans were compared with this optimum, with the following results:

Land Use: A 3-per cent shift of cropland to permanent pasture, compared with an 11-per cent optimum. A 4-per cent shift from lespedeza and grain to deep-rooted legumes (red clover and alfalfa) compared with a 10-per cent optimum. A 2-per cent shift in row crops and in small-grain acreages compared with an optimum of 4 per cent.

Yields: Corn and hay yields increased 31 and 41 per cent respectively, compared with optima of 42 and 54 per cent.

Feed Crop Production: Roughage increased 43 per cent, and grain 19 per cent — total T D N's, 29 per cent. The optima: 46 per cent, 24 per cent, and 33 per cent.

Livestock: Roughage-consuming, increased 21 per cent; grain-consuming, 11 per cent, which is only two thirds as much as the feed.

[6] Tennessee College of Agriculture, University of Tennessee, and the United States Department of Agriculture Co-operating, *Progress and Possibilities for Further Progress on 50 Unit Test-Demonstration Farms in the Valley of East Tennessee*, June, 1942. The budget analysis and planning were largely done by W. Herbert Brown under the guidance of E. C. Callahan, both of the Tennessee Agricultural Extension Service, with John D. Black and Walter W. Wilcox serving as consultants for the T V A.

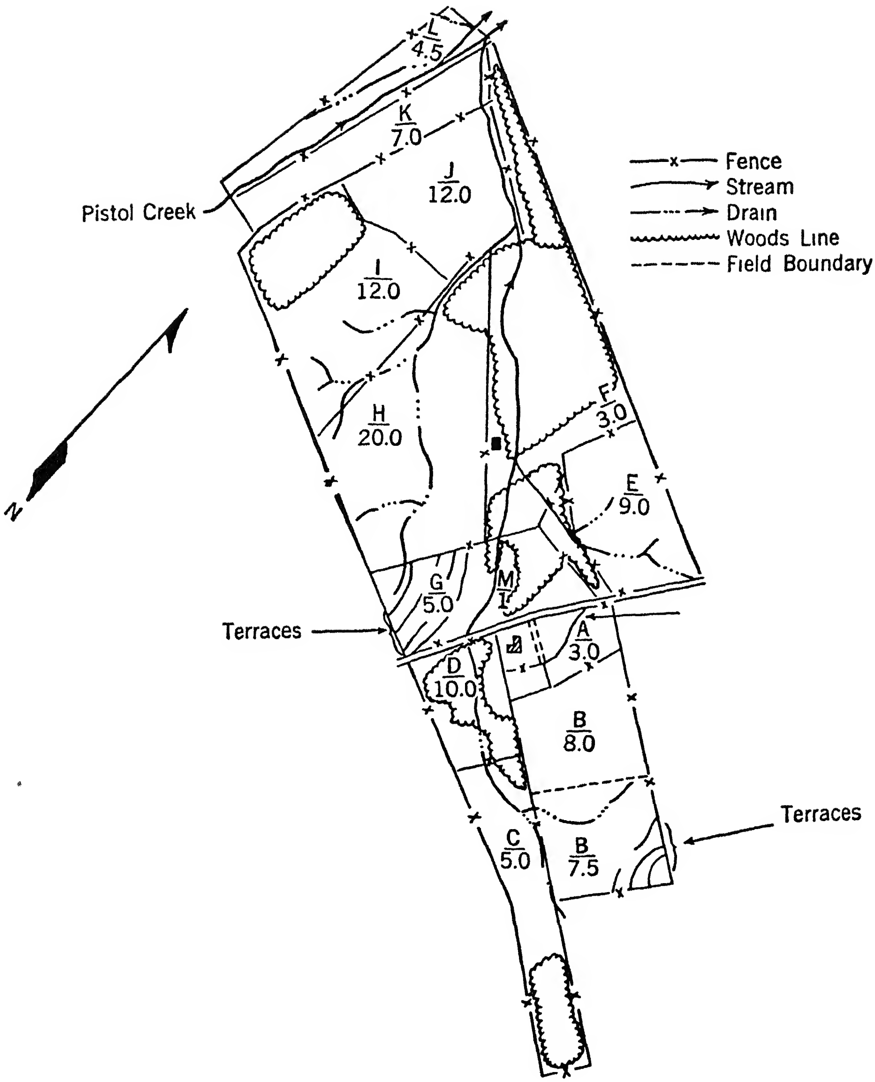

CHART 87. Land use and field layout of a 135-acre test-demonstration farm in Blount County, Tennessee, 1943.

A. Alfalfa
B and B[1]. Wheat-lespedeza
C. Pasture
D. Pasture
E. Silage-truck-tobacco
F. Pasture
G. Oats-lespedeza
H. Grass hay
I. Pasture
J. Oats, followed by pasture
K. Pasture
L. Corn
M. Pasture

The farmers lagged in increasing their livestock numbers because of inertia, lack of capital or credit, and lack of barns and fencing.

Net Farm Income The average net farm income in 1940 was $580; if the optimum plans had been realized, it would have been $870.[7] The major portion of the additional $290 would have come from fuller utilization of feed produced. The average increase in net farm income attributable to the changes has averaged $100 per year, but had been increasing until it was $200 in the last year. There were large differences in the progress made on these 50 farms, from 6 showing losses in net farm income to 9 showing gains of $900 and over. The optimum farm plans set up were on the whole conservative. They took into account the limitations under which these 50 farmers were operating. A few of them managed to overcome these handicaps and to exceed their optima. The sample chosen was normal as to age distribution. The test-demonstration farmers averaged considerably above normal age in 1941–1942. In general, the older farmers made less progress than the younger.

These net farm income figures do not include gains from the increase in the value of the farms because of improvements added and increase in productivity. The nature of these is indicated by the four farms taken for examples. They are of the same general type as reported for the tenant-purchase farms, though not usually as large relative to the starting values.

HEARD COUNTY, GEORGIA[8]

The most thoroughgoing attempt at farm replanning yet undertaken is with a group of ten F S A standard loan clients in Heard County in the Georgia Piedmont, by the Bureau of Agricultural Economics and the F S A, with the assistance of the Forest Service and other agencies. In this case, about the only factor taken as fixed is the amount of land. The objective is to provide as good an income and living as possible for these ten families from their present farms. One plan calls for shifting a 153-acre cotton farm completely to beef cattle and establishing 40 acres of kudzu for hay and pasture, this to raise the net farm income from $120 to $700. Another calls for converting a 93-acre one-mule cotton farm to one substituting sweet potatoes for some of the cotton and building up a small dairy herd on the basis of kudzu fields. A loan was made

[7] These figures and others in the analyses were adjusted for price changes and weather abnormalities.

[8] W. T. Wilson and James C. Downing, Bureau of Agricultural Economics in cooperation with Farm Security Administration, *Three Years of Experimenting with Farm Reorganization in Heard County, Georgia, 1942–1943–1944*, 1945.

to build a sweet-potato curing house. The program is expected to raise the income of this farm from $250 to $1,800. Two other plans call for sweet-potato enterprises like this one. Most of the plans retain cotton, but add dairy cattle, and/or poultry and something else. Separate farm woodland plans were also made for all ten farms. *The net income of these ten farms would be increased fourfold on the average if the plans were carried out — and these plans were made to be carried out.* The F S A advanced the capital needed, and various agencies furnished the supervision. The project was started in 1941. Four families have dropped out, because of illness, shifting to war work, or for other reasons. The high wartime prices of cotton have prevented some of the shifts called for in the plans. But a large fraction of the kudzu called for in all the plans has been planted, and enough progress has been made on several of the farms to indicate that the optima are attainable, if the farmers prove equal to their opportunities.

F S A STANDARD-LOAN FARM PLANS

The farm plans on which the F S A makes its five-year standard loans specify a five-year schedule of farm operations and developments, and of advances to cover them and repayments. *Around a half-million such plans have been made since 1935 and reexamined each year until the loan has been repaid.* There is little time, obviously, for analyzing alternatives to discover the most promising program. The county F S A supervisors for the most part simply introduce the types of changes which are believed to be best in the area, except as they may need to be modified to fit the particular farm and family.

PLANNING NEW FARMS

Given a particular tract of land to make into a new farm, the job of planning is almost identical with what has been outlined above. The only difference is greater freedom in locating the farmstead and in the field layout. Additional problems arise in planning new farms only when a tract of land is to be laid out in a group of farms. Decisions must then be made as to how much land to put in each farm, and what kinds of land, and what particular fields. The primary objective in such planning is to place the different pieces of land into that combination with the others that will enable them to contribute the most to the total net product of the area. A decision on other grounds will need to be made as to whether, first of all, to have just one big farm, or whether to have

units large enough so that many of them employ two or three hired men, or whether to have only family-size units for the most part. No doubt in some cases, operating the tract as one big farm would yield the largest net product if that were the sole consideration.

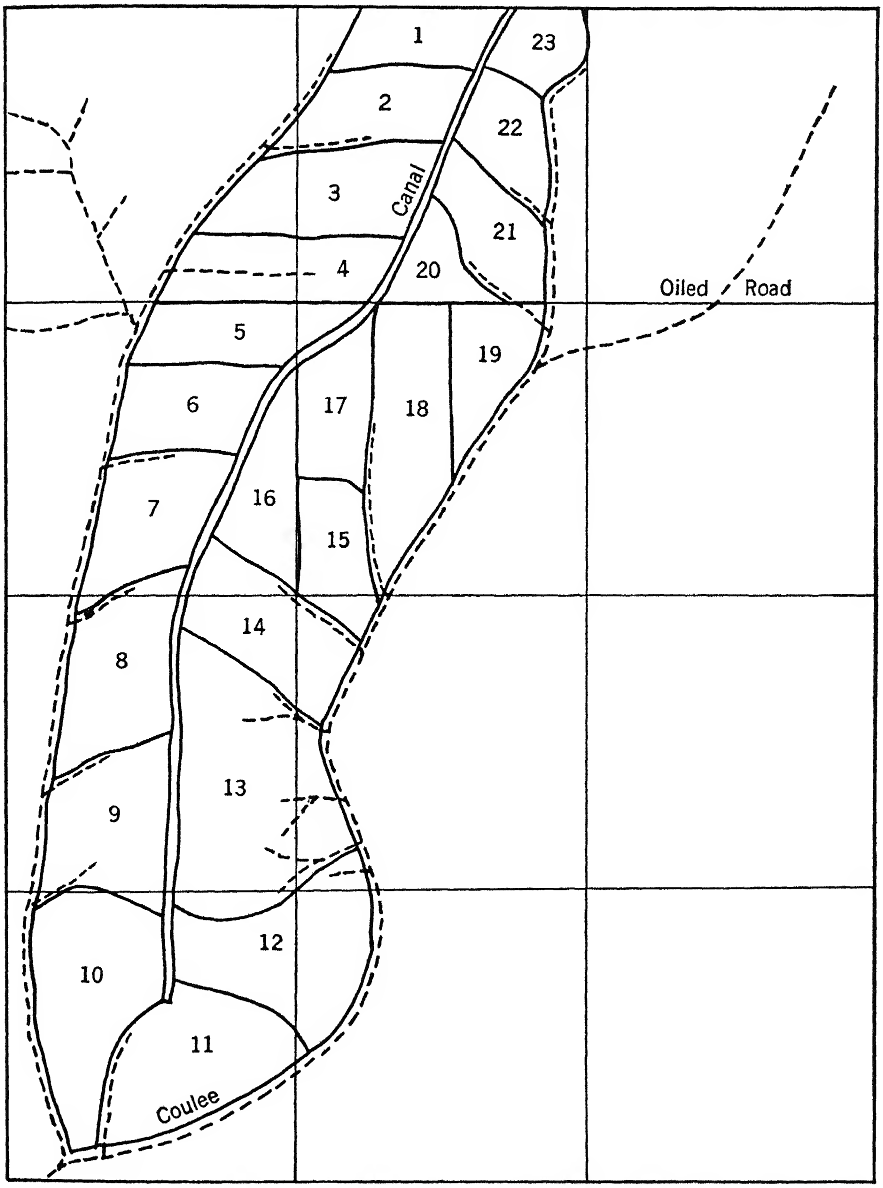

CHART 88. Subdivision into farms of a section of the Columbia Basin.

Another major consideration will also be the market outlets for potential products of the area and the relative prices of these likely to prevail in the local market.

PLANNING THE COLUMBIA BASIN FARMS Most of the planning of new farms in this country in the near future will be in the West on irrigation projects. Perhaps 50,000 new farms will be created in such projects in the first postwar decade. The Columbia Basin Project in Central Washington alone will provide 15,000 new farms. Its problems are typical, and its planning has been carefully studied.[9]

The canal system in an irrigation project ordinarily follows the higher land so that the water flows by gravity onto the land. Chart 88 shows a branch of the main canal following the crest of a broad flat ridge with a coulee or draw a half mile away on either side. The farm units obviously run from the main canal to the bottom of the slope, or divide the slope between two farms. Unfortunately, the farms do not face on the established road, and hence sideroads will be necessary.

The layout of Farm No. 17 is shown in more detail on Chart 89. The arrows show the direction of flow for irrigation water on each field. Field A is Land Class 1, in the Bureau of Reclamation's classification, which means that it has a moderate slope and is well adapted to irrigation of row crops without serious erosion. The rotations prescribed for it are 5 years alfalfa, 1 year sugar beets, 1 year grain, and 1 year grain as a nurse crop for an alfalfa seeding; or a 2-year rotation of sugar beets and grain and sweet clover. Fields B, F, G, and H are nearly all Class 2T.[10] The soils are as good as on Field A, but the slope is 5 per cent or a little more. This field will be kept in alfalfa 4 years out of five. Fields D, E, and I are largely Class 3T, with slopes up to 10 per cent. Field E will be put in permanent hay, and plowed only often enough to renew the hay seeding when it has run out. Fields D and I will be in permanent pasture. Much steeper slopes can be irrigated when sodded, without serious soil erosion, than could be used safely for row crops or even for alfalfa. Field J, a long narrow strip that can be irrigated occasionally with waste water, will be planted to trees (probably black locusts) to provide fence posts and fuel, as well as shelter for wild life.

These rotations and land uses have been chosen because budget

[9] United States Department of the Interior, Bureau of Reclamation, *Columbia Basin Joint Investigations*, *Types of Farming*, Problem 2, 1945.

[10] In the Bureau of Reclamation land classification, the letter gives the reason the land is not Class 1; T for topography, S for soil depth or texture, ST for a combination of soil and topography, D for drainage, R for rocks in the plow zone, etc. Class 1 is the same as the Class II in the S C S system; Class 2 the same as S C S III, etc.

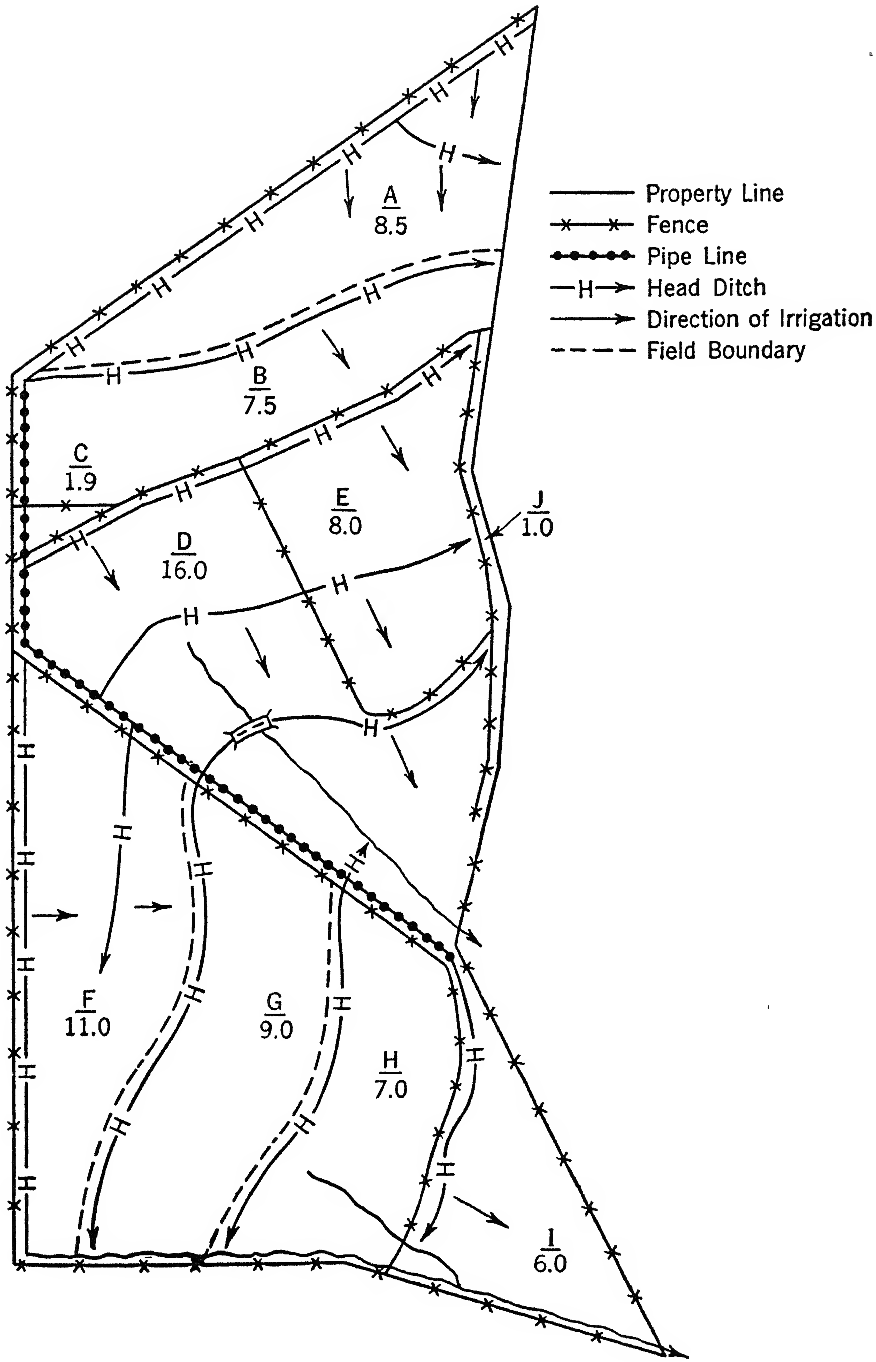

CHART 89. Farm plan for Farm 17 in Chart 88.

analysis indicates them to be the ones that will return the largest income without depleting the soil. The budget analysis required estimates of crop yields for each land class and under each rotation. This had to be based on yield data from other areas, adjusted for climatic differences, and differentiated by land classes and crop rotations. Realistic estimates of crop yields are basic to farm planning on irrigation projects. The relatively small overestimate of a half ton per acre in the yield of alfalfa, with the consequent overestimate in livestock numbers, will lead to serious errors in figuring net farm incomes and sums available to pay debt charges.

These rotations combine to form the following average crop acreages and production:

	ACREAGE	YIELD PER A.	TOTAL PRODUCTION
Sugar beets	6.6	15.2 tons	100
Barley	12.9	25.6 cwt.	330
Alfalfa hay	29.6	4.2 ton	124
Permanent pasture	18.4	10 AUM	184

The permanent pasture produces 184 animal-unit-months of feed. Sugar-beet tops, sugar-beet pulp, straw, and pasturing on alfalfa after the last cutting produce additional feed. Only the sugar beets are sold; at $5.50 per ton, they bring in $720. The other crops support 25 cows, producing 240 pounds of butterfat per cow, plus the necessary replacements, and 5 brood sows and 25 hogs plus replacements. Most of the hay and miscellaneous feed goes to the dairy cattle; most of the barley and skim milk to the hogs. Very little feed is bought. The gross income is estimated at $3,350 at 1941 prices, and the net income at $1,480 after $185 is taken out for water charges. In addition, $200 a year for 40 years is due to repay the cost of the irrigation system.

The study of market possibilities showed that other Western areas were already producing about all the potatoes that could be sold. Sugar beets promise to be a profitable crop if government support of programs for sugar continue. Alfalfa could be grown instead of sugar beets on Farm 17, but the net income would be lowered because the crop is less labor-intensive. About 6 more cows could be kept if the sugar-beet acreage was reduced.

REPLANNING EXISTING AREAS

Situations are constantly developing which call for taking an area now in one pattern of farms and land use and converting it to another. Such a conversion was called for when the boll weevil reduced the yields

of cotton in many sections of the South to a point where the existing pattern of farms and tenure could no longer survive and large areas were abandoned and allowed to grow up to brush and trees. If these tracts could have been promptly converted into general farms two or three times the size of the former holdings, with considerable acreages of pasture for cattle, they might well have been kept in agriculture. The wearing out of the land from overcropping and increasing erosion may produce a similar situation; or the loss of markets may make it no longer feasible to continue certain types of farming. The building of the dams in the Tennessee River and its tributaries, and resulting flooding of the bottom lands that were the principal dependence of many farmers, also created a number of situations of this kind.

An excellent example of such a situation is an area in one of the Southern states at the confluence of two rivers. This land always has been flooded from time to time, but its fertility is such that the first crop could be lost in occasional years and still the farmers would prosper. With the removal of the forests from the headwaters, however, the floods have increased in frequency and severity, so that now the crops are damaged severely or destroyed every two or three years. The farmers are losing out and the land is in prospect of reverting to timber. If, however, these bottom lands could be combined with the highlands on either side into units that included both, and the farmsteads moved onto the highland, the bottom lands could be used to grow feed crops and forage, and supplies of these could be carried over from good years in such a way as to make successful farming possible year in and year out.

The planning procedure to be followed in situations such as described is usually some combination of replanning existing farms and of laying out farms in a new tract. Part of the old farmsteads may be usable. Some of the existing farms may be used as a nucleus for consolidations. The major problem is determining what system of farming to pursue in the area. This calls for the same careful analysis of market outlets as outlined for the Columbia Basin. The size of unit and combination of types of land need also to be worked out. Decision must be made as to the best use for each field, and the fields need to be fitted together into economic farming units. Soil surveys are highly useful, and in some cases altogether necessary, in such replanning. Tests of the productivity of the different kinds of soil in various crops and rotations may be a highly desirable preliminary.

The Farm Ownership branch of the F S A has formed a few thousand tenant-purchase units in the past five years by buying large farms or small plantations and subdividing them into economic units and erecting

the necessary farm buildings. Thus, one plantation of 852 acres in Sumter County, Georgia, was made into 8 two-mule farms ranging in size from 104 to 112 acres; and part of the Willow Glen plantation in Rapides Parish, Louisiana, was made into 20 units of 40 to 65 acres combining cotton, truck crops, and livestock. The land had to be redivided because the plantation units were much smaller.

Under the Land Utilization Program, now administered by the S C S, replanning takes the form of taking land out of farms altogether and putting it into sizable tracts of hay land, grazing land, or timberland, to be leased to the surrounding farmers. This program was begun in 1933 as a way of salvaging families on "submarginal land." It has been continued since as a method of salvaging the land. In 1944, the S C S was administering directly 82 such areas containing three million acres; and 23 areas containing four million acres through state and local agencies. The improvements on these lands consist of seeding and sodding, liming and fertilizing, tree planting, mowing and brushing, fencing, providing stock-water facilities, and building roads and trails. The use permits were as follows in 1943: grazing, 5,500; timber cutting, 1,100; haying, 480; and cropping, 470. They yielded the government an income of a half million dollars.

PLANNING THE FARMSTEAD

In planning a new farm, and sometimes in replanning a farm, one has a chance to choose the best location for a farmstead and to lay it out in the best way. As indicated in Chapter II, many different styles and types of farmsteads are found around the world, and even in various parts of the United States. Usually there are good reasons for the differences, but some of them merely continue a tradition well past its time. Some of the traditions were brought over from Europe and do not fit this environment.

The actual process of planning farmsteads reveals very quickly that the perfect farmstead rarely if ever exists. Different types and plans have advantages and disadvantages, and the actual farmstead is a compromise among these. The easiest way to demonstrate this is to take an actual farmstead and analyze its planning problem. The one chosen, shown in Chart 90, is on a Midwest farm.

1. This farmstead is on the north side of a road running east and west through the farm in such a way as to separate 50 acres of permanent pasture and woodland on the north side of the road from 110 acres of plowland on the south side. The farmstead is thus protected from

the north winds by the high hill on the back and the timber on part of it. The cowyard, J in the chart, is on the south side of the barn, protected from the north winds and also fronting the southern sun. Note that the cattle have ready access to the barn and yard from the pasture and vice versa.

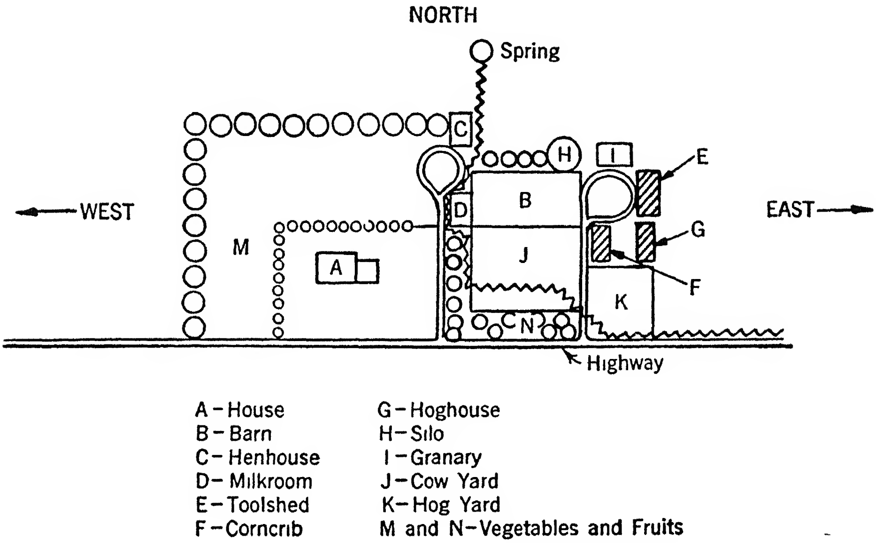

CHART 90. Plan of a farmstead on a Midwest farm.

2. The spring located just in the rear determined the exact location of this farmstead along the road. This spring provides water for the house, the poultry, and the milk room, the barn B and yard J, and even the hog yard. The spring is 30 feet above the level of the barn floor and house, which simplifies the water supply problem.
3. Although the road uses some of the farm acreage, it provides very good access to the fields across the road both summer and winter.
4. The farm buildings and yards are east of the house, so that the summer winds will blow the barnyard odors the other way.
5. Two farm roadways give access to the farmstead, one to the dwelling, the poultry house, and the milk house, from which the milk is collected every day. The other roadway gives access to the barn, the silo, the tool shed, and the corncrib. The hay is unloaded from this roadway at the east end of the barn. Many barns in this region are built with a central driveway on the second floor. This could have been arranged easily on this farm, but it was thought better to save the hay storage space that is wasted by a central driveway.

6. The hoghouse is as far from the dwelling as possible, and is shut off from it by other buildings.
7. Many planners will say that the cowyard is too near the dwelling. It is shut off, however, by a row of tall shrubs. The alternative would have been to put the buildings on the south side of the road. The cowyard would then have been on the other side of the barn from the house, and still facing south. But this would have meant separating the pastures from the barn and cowyard by a public highway.
8. The work-yard between the barn and the tool shed is well located, and is economical of space. Many farmsteads have an acre or so of largely wasted area.
9. The buildings are located in such a way as to reduce traveling almost to a minimum. The barn, milk house, and poultry house are near the farmhouse. The tool shed is near the barn, and the corncrib is near the hoghouse. The kitchen garden is immediately adjoining the farmhouse.
10. The farmstead lies on the slope of a hill so that it is well drained. Water from heavy rains and melting snows would flood the farmstead a little at times if this were not taken care of by low dikes and drainage into the small brook that carries off the spring water.
11. The farmstead is protected on the north and west by a windbreak of tall evergreens.

The planning of the farmsteads in the Columbia Basin project offers some special problems. The wells are so deep and costly that one well must serve a group of farms, which involves interconnecting pipelines. The planners preferred to locate the farmstead of Farm 17 (Chart 89) in Field 3, even though this involves piping water from the main pipeline which will run along the ridge, and also a stub road to this farm and No. 15. The winds will be strong on the crest of the ridge.

A makeshift shelter may serve as a house for the first few years. An unavoidable nuisance during the first years of settlement will be the dust from the land as it is being leveled and cultivated, and from the roads before they are paved or graveled.

EXERCISES

1. Obtain specimen farm plans developed for farms in your state by the S C S, the F S A or other agencies and test them out as to their soundness by the methods outlined in Chapter XXVIII.
2. Take a tract of farming land in a familiar area and lay it out into the best possible combination of farming units without regard to its present division into farms.

CHAPTER XXX

The Management of Rented Farms

THIS CHAPTER CONSIDERS THE SPECIAL NATURE OF THE MANAGEMENT, and the additional management problems, of a farm managed by two parties ordinarily called the landlord and the tenant, instead of being managed by one person, the owner-operator. Obviously this subject can be approached from the standpoint of either the landlord or of the tenant. It is approached from both in this chapter.

If we are thinking of all landlords in the country as one group and of all tenants as another group, and are also thinking of management in terms of the longer-run results, the interests of the two groups are identical. Under these assumptions, both are interested in keeping the farms at a high level of productivity; both need to have farms managed in such a way as to maximize the continuing income from them. The more that the farms are made to earn, the larger the returns for both of them. But rental contracts are between individual pairs of landlords and tenants and for a few years at the most. Under these conditions, the tenant is likely to be mainly interested in immediate returns. Many landlords are interested in relatively short-run returns also; they may need all the income from the farm which they can get to support them; or they may be temporary owners only. But in general the landlords have a longer-run interest than the tenants. Hence, there tends to be a conflict of interest between landlord and tenant, and this poses one of the central problems of the management of such farms.

The other major problem in such management is the division of the income of the farm between the landlord and tenant. The relationship here is somewhat like that between employer and employee, or perhaps between buyer and seller. The landlord has a farm which he wants worked, or the use of which he wishes to sell for a year, or a term of years. This is clear enough when the rental contract calls for a cash rent. It is no less true, however, if the rent is paid as a fixed amount of product or a share of the crop or livestock receipts which fluctuates from year to year with yields and prices.

THE PLACE OF TENANCY IN AGRICULTURE

The facts about tenancy presented in Chapter IV strongly suggest that landlord-tenant management may very well have a useful place in agriculture in spite of frequent popular beliefs to the contrary. This suggestion takes on more strength when we consider the alternatives to tenancy. If young men looking to agriculture as their life work are not to be tenants in their early years, they must either inherit enough resources to start as full-fledged owner-operators, or else start as hired laborers. In their earliest years, they can acquire their needed agricultural skills and knowledge to very good advantage as laborers on a good home farm or on neighboring farms, but they also need to acquire ability in managing. An apprenticeship as a part manager under a good lease may be a highly effective arrangement. As a tenant, the young man accumulates resources and managerial experience more rapidly than as a hired laborer. This apprenticeship may be in two stages, first as a share tenant and then as a cash tenant.

Some think it unfortunate that all farmers' sons do not receive enough help from their parents so that they can start in as owner-operators. But young men without any apprenticeship in management often fail badly.

A similar set of alternatives presents itself at the stage when the tenant is getting ready to become an owner-operator. If he buys a small farm or a cheap farm, he can make the change rather soon. But he commonly does better to use his limited resources as working capital on a good rented farm and to let the landlord carry the fixed investment. Or he may buy a good farm under contract or under a very heavy mortgage at this stage. This introduces a large element of risk. Too many young farmers bought farms too soon in the period from 1900 to 1920 because they wanted to take advantage of the rapid rise in land values. A common saying among farmers in those years was that no money was to be made in renting farms; that the only way to make money in agriculture was to buy a farm and cash in on the rise in its value. This policy proved fatal in the 57 per cent decline of land values in 1920 to 1933.

Finally, the combination of the experienced management of landlords who are either retired farmers or are still farming, with the vigor and aggressiveness of young tenants, may be very effective. One of the shortcomings of having all agriculture organized in family farms is that the superior ability of the very good farm managers does not have enough scope for its application. If a landlord with this ability spreads it over several farms with young tenants upon them, the tenants may profit very greatly from it. The senior author once studied several such com-

binations in the dairy-farming regions of Wisconsin. On one of these, seven farms had been stocked with very good Holstein cattle from a parent herd on the original farm. The buying and selling was largely arranged by the landlord, and likewise the rations for the cows. Before the Big Depression, the tenants on these farms were graduating from tenants to owners in five to seven years.

What should the percentage of tenancy be in a reasonable system of land tenure in such a country as this? If we assume an agricultural ladder in which all the operators become tenants before 30, and at an average age of 27 years, and owners before 40, and at an average of 35, and retire from active farm operation before 70, and at an average age of 60, the owners and tenants would be distributed somewhat as in the second section of Table 74. This would mean that approximately 30 per cent of all farms were rented. Probably this 30 per cent needs to be raised to 35 per cent to allow for those now laborers who should be tenants, in the South especially, and for at least one farmer in ten beyond the age of 40 who would do better for himself and his family if he were content to have a landlord assume the risks of owning the fixed capital.

TABLE 74. PERCENTAGE OF OWNER-OPERATORS AND TENANTS IN EACH AGE-GROUP IN 1940, AND ALSO PERCENTAGE UNDER AN ASSUMED REASONABLE TENURE SYSTEM IN THE UNITED STATES

Age-group	*Actual age distribution, 1940*		*Assumed agricultural ladder*			
			Age distribution		*Number per 1,000*	
	Owners (per cents)	*Tenants (per cents)*	*Owners (per cents)*	*Tenants (per cents)*	*Owners*	*Tenants*
Under 25	2.0	9.2	2	10	250	750
25–29	4.0	13.3	4	25	270	730
30–34	6.4	14.2	7	35	320	680
35–39	9.1	14.7	12	30	480	520
40–44	11.4	12.6	18	0	1000	0
45–49	14.2	11.4	16	0	1000	0
50–54	14.5	9.7	14	0	1000	0
55–59	13.7	7.5	12	0	1000	0
60–64	12.5	5.3	10	0	1000	0
65 & over	12.2	2.1	5	0	1000	0
	100.0	100.0	100	100		

How much tenancy a country should have depends, however, largely upon how good its tenancy is. If the leasing arrangements now in use in this country cannot be improved, we should have fewer renters than the 35 per cent. If leasing arrangements such as prevail in England and Wales can be developed in this country, twice the 35 per cent would not be seriously objectionable. The duration of occupancy of tenants in England and Wales is probably longer than on the owned farms in this country, and the land and buildings are better maintained by their tenants. More important, the tenants are much more secure than they would be with the heavy mortgages under which many farms are held in this country. Hence it follows that improving leasing arrangements is fully as important as reducing the proportion of tenants.

APPLICATION OF THE PRINCIPLES OF FARM ORGANIZATION ON RENTED FARMS

In the foregoing chapters, a number of important principles have been developed that determine the most advantageous organization of producing enterprises in agriculture and the best use of land and labor, equipment, feeds, and fertilizers. We need now to see how these principles apply when the receipts and expenses are shared between the landlord and tenant in various ways.

INVESTMENTS IN LAND AND BUILDING IMPROVEMENTS Under the usual one-year cash lease in force in this country, the tenant obviously can afford to invest nothing in his business except labor, seeds, and fertilizer, the benefits of which are largely exhausted in one year. If he is operating under a secure lease for five years, he can afford to make investments at the start that will pay for themselves in the succeeding four years. Applying lime and phosphate to pastures and meadows qualifies under this description; also establishing stands of red clover, lespedeza, and even alfalfa. In some cases, a limited amount of easy clearing and draining may be profitable, and more often a certain amount of strip-cropping and the like. If the lease is on a share basis, the tenant of course receives only a fraction of the returns from the investment. He therefore cannot ordinarily undertake such improvements unless the landlord shares in the investment in them at least in proportion to his share of the receipts. The tenant may properly expect some additional compensation if he has to supply much labor.

Regardless of the length of the lease, a break is likely to occur in the last year or two of it unless the landlord is willing to cover about the

whole expense of such investments as establishing pastures and meadows or applying lime and phosphate.

Even though a lease is written for five or ten years, tenants in this country are not usually sufficiently secure against disturbance so that they make all the short-run investments needed for really good farming. The only adequate solution of this problem is to provide in the lease for compensating the tenant for the values of any improvements which have not been exhausted. In England and Wales, the Agricultural Holding Act of 1923 takes care of this. Usually under this Act, the landlord and tenant agree as to the amount of the compensation, following the customary rates that have come to be recognized in the community. If they cannot agree, two professional "valuers" are called in. If these do not agree, a third valuer may be called in, or an arbitrator, and as a final resort the dispute is brought before the County Court.

The improvements which the tenant may make are classified under three heads in the Agricultural Holdings Act. The Class I improvements require the consent of the landlord. They include new buildings, silos, permanent pasture, roads, bridges, permanent fences, orchards, water supply, land clearing, and irrigation works. The Class II improvements require only that the landlord be notified. These include mainly drainage, building repairs, and the like. If the tenant proposes repairs to farm buildings, however, he must notify the landlord and give him a reasonable time in which to make them. The Class III improvements are applications of commercial fertilizer and lime or purchased manure, or manure produced from purchased feedstuffs, and even manure produced from feedstuffs grown on the farm. These improvements can be made without the landlord's consent and even without notifying him that they are being made. Two qualifications are attached to all of these provisions, namely, that the improvements cannot be made in the last year of the lease without the consent of the landlord, and that the tenant must move off the farm before he presents his claim for compensation.

Such provisions are not commonly included in leases in this country. G. A. Pond reports that only 18 per cent of the leases which he examined in Minnesota contained them and that they mostly covered only fall plowing and sweet-clover and alfalfa seedings.[1] O. G. Lloyd reports, for a sample of rented farms in six Indiana counties, 40 per cent of the tenants repairing fences and getting paid for it. The comparable figures for erecting fences was 28 per cent; for labor in erecting buildings, 12 per

[1] George A. Pond, *Farm Tenancy in Minnesota,* Minnesota Bull. 353, 1941.

cent; and for seeding crops harvested by the next incumbent, 9 per cent.[2] Model leases which the senior author published in Wisconsin in 1918 included full provisions for such compensation.[3] The three leases publicized by the Illinois Extension Service all include such provisions.[4] But still very few of the leases written provide for such compensation, or if they do, they cover only simple items like fall plowing, fall seeding, or fence repairs.

In England and Wales, even the foregoing provisions are not considered as giving all the security which the tenant needs; the Holdings Act provides also for compensation to a tenant for being disturbed not only before the end of his lease, but even though the lease designates a limited term. *It is assumed in England and Wales that the lease will be renewed.*

DEPRECIATION AND APPRECIATION Compensation for unexhausted improvements does not cover the general sustained depreciation of rented farms arising from keeping the land too much of the time in annual crops, especially in row crops, from keeping sloping lands in crops that should be in sod, and from allowing fields to become infested with foul weeds. As pointed out elsewhere, the full effect of such abuse of land under lease is often concealed because the same farm is not rented indefinitely, but alternates from owner to renter operation. Under such abuse, the capital values in the land are being used up and converted into current income. If the lease is a cash lease, the tenant gets all of this income. If it is a share lease, it is divided between them. The written leases usually contain a phrase which requires the tenant to operate the farm in a "husband-like manner and to perform seeding, cultivating, harvesting, and plowing at the proper time and in the proper manner." But obviously such a stipulation is difficult to apply. More significant are the provisions in some leases that no fields in sod shall be broken except with the consent of the landlord.

The Agricultural Holdings Act of England and Wales provides for such control under the heads of "compensation for deterioration and waste" and "compensation for high-quality farming." At the termination of a tenancy, the landlord may present a claim for compensation from the tenant for any loss in the value of the land caused by the failure

[2] O. G. Lloyd, H. S. Morine, Jr., and J. R. Hays, *Principal Methods of Share Renting and Compensation for Unexhausted Improvements in Four Type-of-Farming Areas in Indiana*, Purdue Bull. 464, 1942.

[3] B. H. Hibbard and J. D. Black, *Farm Leasing Systems in Wisconsin*, Wisconsin Research Bull. 47, 1920.

[4] H. C. M. Case and Joseph Ackerman, *Farm Leases for Illinois*, Illinois Circular 503, 1940.

of the tenant to cultivate it according to the rules of good husbandry or the terms of the lease; or at any time during the lease if a tenant has sold a crop off the land for cash, unless he returns fertilizer to the soil equal to that which was sold with the crop; also for damages from "waste wrongly committed or permitted by the tenant." The tenant, in turn, may claim compensation for increasing the value of the land, if there has been a written record of the condition of the farm at the beginning of the lease. Both of these claims for compensation must be presented before an arbitrator who functions under regulations laid down in the Act.

INTENSITY OF FARMING Some renting arrangements promote intensive farming and some the opposite. Under a cash lease with the landlord furnishing the land and buildings, the tenant is disposed to farm clear to the highest-profit point, counting in the cash rent as a fixed input. Since he receives the full return for any labor or other inputs, his marginal inputs and prices equal each other at the same point as upon an owner-operated farm. The share tenant operating on the half-and-half basis that prevails in the Midwest, however, gets only half of the additional product from the last unit of labor applied, and hence comes to the points of least-cost and highest-profit combination much sooner. The tendency is, therefore, for share tenants to economize on labor by farming less intensively and by using laborsaving methods. They are likely to have less of their cropland in corn and more of it in small grain and to sell their grain rather than to feed it out.

The landlords, in turn, stand all the costs of providing the buildings, farms, and land, and get back only half of what these contribute to the product. Their inducement to provide good buildings, and especially a comfortable farmhouse, is mainly in that they attract better tenants in this way. This may mean much more in returns than the savings from providing low-grade buildings.

In general, the other variable expenses are divided in the same proportion as the proceeds. Cotton croppers, for example, pay for half the fertilizers, seed, and ginning and get half the cotton. Purchased feed on dairy farms is divided like the proceeds in the half-and-half dairy basis common in the Midwest. This arrangement tends somewhat to favor the landlord, since the tenant has the extra labor of harvesting the larger crop resulting from using more fertilizer. He may be well rewarded at that, but not so well as the landlord. This would be apparent if the tenant had to hire extra labor by the bushel or bale on a piece-rate basis to harvest the larger crop. In the case of livestock, the tenant has

the extra labor of caring for the additional livestock that goes with buying more feed. Many share renters of dairy farms therefore do not buy as much feed as owner-operators. To control this, some share leases specify the minimum number of milk cows to be kept. Other landlords arrange to pay for some of the extra labor. Beef-cattle farms, or the livestock part of crop-livestock farms, on the other hand, are likely to be rented for cash — landlords are not disposed to give tenants half the proceeds from a beef-cattle enterprise with its relatively small labor inputs. They are very glad to rent their farms on a share basis if the cows are milked, because the tenant has to do all the milking.

DIVISION OF FARM INCOME BETWEEN LANDLORD AND TENANT It is obvious enough that the rental paid determines how the net farm income of a cash-rented farm is divided between the landlord and tenant. The level of cash rents is established in a market just as is the level of prices for farms. It is ordinarily a poorly organized market, but nevertheless it is a market. In this market, the landlord is a sort of a middleman. If he owns a farm, he owns all the future uses of it. He then retails this farm out, a year's use at a time, to the tenants, who have not the means to buy all the uses of the land, present and future, at one time. The cheaper the landlord middlemen are able to buy such farms, and the higher the rents they are able to obtain, the larger is their middleman margin.

It is ordinarily assumed that competition between landlords, tenants, and owner-farmers, on the one hand, and between different landlords on the other hand, is sufficient to keep these margins at a reasonable level. If they ask too high rents, young men aspiring to be tenants will remain farm laborers or move to town, and the older tenants will buy farms if they are able or else quit farming. If this is not enough to keep landlords' margins from rising above a normal competitive level, more and more men will try to be landlords and this will beat the margins down.

The rental for a particular farm involves a matching of grades of farmers and grades of farms, like the matching of cows and dairymen described in Chapter XVIII. The poor farms tend to be rented by the poorer farmers for what they can make out of them. Tenants who are short of capital frequently have to be satisfied with poorer farms than their ability as farmers warrants.

Share-rental terms and agreements are just as truly prices as cash rentals are. In one respect, they are more flexible than cash rentals; in another, less so. The payment to the landlord adjusts itself more or less

automatically to changing prices and yields. Because it does this, however, the terms of such leases become customary and difficult to change as systems of farming or technologies of production change. Thus arises the tendency noted for landlords to expect tenants to care for all the cows when an area becomes part of a big city milkshed; and in some sections for tenants to pay only a share of the grain as rent after the farms have shifted somewhat to dairying. The usual way of meeting this latter situation in the Midwest, we shall note, is to rent the farm partly on shares and partly for cash.

The adjustment between grades of farms and farmers under share leases is similarly automatic — the poor tenant on a poor farm pays the landlord a low-share rent because the product is small. But even then it may leave too little for the tenant.

Fixed cash rentals cause difficulty even with one-year leases when prices drop sharply in midseason, as they did in 1920 and in 1930, or when a drouth strikes. They cause even more difficulty with long-term rentals. Accordingly, various schemes have been proposed for adjusting the rentals. Some of these cover price changes only; others, yields also. They seem to be more widely used in California than elsewhere. Rents on dairy farms there are frequently based on the price of milk the preceding month, and are paid monthly in advance. In one area, they vary by months according to the seasonality of production. Some leases on farms producing cotton, grapes, and prunes also have sliding scales.[5] Suggestions have even been made to base the rents on the net farm incomes as figured in farm account books.

The incomes of share tenants and croppers are low in the South in the main because all the farming is labor-intensive. This affects the returns of owner-operators as well as tenants. But it particularly affects the incomes of share tenants and croppers because they contribute the labor.

TYPES OF LEASES

The census separates out five classes of leases; cash, share, share-cash, cropper, and "other." The last includes principally the "standing renters," that is, those that pay a stated amount of farm product as rent, such as two bales of cotton or 500 bushels of corn. Standing renters have been enumerated separately only for the South. There were

[5] R. L. Adams and William H. Smith, Jr., *Farm Tenancy in California and Methods of Leasing*, California Bull. 655, 1941. See Iowa Bull. 295 by Millard Peck (1932) for a proposal of a sliding scale on Iowa farms.

104,000 of them when last counted in 1920. Still other types of contracts are in use here and there, and several variants of the five named. Besides, the lines between types of leases cannot be clearly drawn; they merge into each other, the contracts being adapted to fit into particular situations.

CASH LEASES The usual cash lease is very simple, covering only the amount of rent and how it is to be paid and when, the custom of the community being relied upon to determine the other terms of the lease. This means that the tenant is largely free to farm the land and buildings in any way that he sees fit provided he does not commit overt acts of destruction. That much more is needed in a good cash-rent contract is obvious from the following written lease which is patterned after those in use by the more careful landlords in the Midwest.

Date THIS AGREEMENT, in duplicate made and entered into this ________ day of ________ ________ 194– by and between ____________, hereinafter known as the landowner, and ____________, hereinafter called the tenant.

WITNESSETH, That the said landowner for and in consideration of the cash rental and agreements hereafter named, does hereby lease to said tenant his farm of one hundred and sixty (160) acres with all buildings and improvements thereon situated in ____________ county, and described as follows: The S. W. ¼ of Sec. 3 in Town ____________, Range ____________, East, a plan of which is included in Exhibit A.

This contract shall remain in force for the term of one year from March 1, 1945 and thereafter for four more years unless either landowner or tenant shall notify the other to the contrary on or before December 1, 1945, said tenant paying said landowner therefor an annual rental of one thousand (1000) dollars. The rental for the first year is to be paid in two equal payments on September 1, 1945 and February 1, 1946 and is secured by two promissory notes for five hundred (500) dollars each, expiring on the before mentioned dates and bearing interest at six (6) per cent thereafter until paid. And if this agreement is extended as before mentioned, then said tenant shall at once execute to said landowner eight promissory notes for five hundred (500) dollars each, expiring on September 1st and February 1st of the four successive years, bearing interest at five (5) per cent thereafter till paid.

DUTIES OF TENANT

Cropping system Said tenant further agrees as follows: to farm said premises in a good and husband-like manner, following a rotation system on the cropland that includes clover or alfalfa two years in five except as winter killing or other climatic factors may make changes necessary; *Seeding* to plow no land now seeded to grass or alfalfa except with the consent of said landowner; to perform all the work connected with sowing whatever clover and grass *Grass seed* and alfalfa seed said landowner shall furnish; to plant not more than forty (40) acres to corn each year, and to keep such corn reasonably free of weeds; *Selling crops* to sell no hay or grain or roughage of any kind except with the consent of said landowner, and to keep enough livestock to feed out all crops grown on said farm; to haul out all manure at least once each year and put most

of it on the land which is next to be plowed for corn; to keep the land from washing by planting and cultivating the corn in Fields B and E on the contour, practicing strip-cropping in Fields F and G, according to the contour lines now marked in these fields, by not plowing through seeded ravines and meadow-strips, and by keeping all washouts filled; to cut or dig all noxious weeds in time so as to prevent their going to seed; to keep all the fences on said farm in good repair and order, the landowner furnishing wire and staples, and lumber for gates; to cut all fence-posts needed for repairs and for new fences; and to furnish half the labor for building all new fences; to keep the barns and other outbuildings in good repair, furnishing all ordinary labor, and to replace all doors and windows broken due to his acts or neglect, or those of his employees; to keep the well and pump and water system in good repair; to haul all materials which are to be used in making repairs or improvements on said farm; and to observe all rules of the ____________ Mutual Insurance Company with respect to tank heaters, threshing engines, etc. *Manure* *Erosion* *Weeds* *Fences* *New fences* *Building repairs* *Well and pump* *Insurance rules*

DUTIES OF LANDOWNER

Said landowner further agrees as follows:. to furnish clover or timothy or alfalfa seed enough to sow well and thickly at least twenty (20) acres each year, and to replace any last year's seeding that winterkills; at the beginning of the lease to put in good repair the well, pump, cistern and all doors and windows, and thereafter to furnish material except posts for all repairs to buildings or fences not occasioned by misuse of tenant or his employees, and to provide one half the labor for all new fences; to repair the roof of the dwelling house on said farm at the beginning of the lease and to make said dwelling house habitable in all ways; and to pay said tenant twenty (20) dollars a year to cut and dig and use all possible means to eradicate the patch of Canada thistles growing on said premises. *Grass seed* *Repairs* *Improvements*

ADDITIONAL AGREEMENTS

It is further agreed that said tenant shall use as firewood first the tops of trees used as fence-posts and after that the down and dead timber and after that the trees designated by the landlord; that said tenant shall pay for all papering and painting and other inside repairs to the dwelling house during his occupancy on said farm and replace all broken glass in windows and doors; that said landowner shall pay all real estate taxes. There will be left on said farm on March 1st, 194–, 40 acres of seeding, 100 raspberry bushes, 25 currant and gooseberry bushes, and a year-old strawberry bed started from 100 plants, and said tenant shall leave the same as to amount and quality at the end of the lease. Said tenant may remove from said farm at the end of the lease enough feed to keep the livestock which he has kept on said farm until the new crop is ready for feeding; but no straw shall be taken from said farm. Said tenant shall not assign this lease nor underlet said premises; and said landowner shall have the right to enter upon and view said premises at all reasonable hours and to make repairs or improvements on said premises; and if either party shall in any respect fail to carry out any of the provisions of this lease, then the other party may hire the same done as herein written and the costs thereof shall be paid by the party failing to carry out said provision; and either party may terminate this agreement on March 1st of any year, except the first or the last, *Firewood* *House repairs* *Taxes* *Quittance requirements* *Sub-letting* *Right of entrance* *Non-fulfillment*

by giving notice on the December first preceding, of his purpose to do so and paying or forfeiting to the other party the sum of two hundred (200) dollars, except that there shall in such case be added or subtracted from said two hundred (200) dollars all amounts due one party from the other resulting from failure to carry out any part of the lease.

Arbitration If the two parties cannot agree as to the amounts due each other, three arbiters may be chosen to determine this, one to be named by the landlord, one by the tenant, and the third by these two.

Quitting of premises And at the expiration of this lease, said tenant agrees to yield possession without further demand or notice of the above described land and premises, leaving them in as good order and condition as the same were in when said tenant entered upon them, loss by fire or inevitable accident and ordinary wear excepted.

All the agreements herein contained shall bind said parties mutually, and their respective heirs, executors and assigns.

Witnesses: Signatures of Contracting Parties:

__________________ ________________________

Landowner

__________________ ________________________

Tenant

This lease has the following objectives: (1) On the one hand, to give the tenant more security of tenure than the usual lease, and on the other, make the landlord more certain of getting his rent. This feature of it is objected to by some landlords and tenants, because they do not wish to commit themselves so definitely. Without such commitment, however, farming under any kind of lease is likely to be slipshod and improvident. (2) To provide for more control of the way in which the land is used. Such control becomes more and more necessary as farms adopt measures and devices for controlling erosion. (3) To protect the landlord and the farm against its being abused by the departing tenant. This is the purpose of the quittance requirements. (4) To provide definite ways of getting improvements and repairs made on the farms. A one-year tenant is not going to build any new fences unless he is paid for it. Neither is the long-term tenant in the last years of his lease. Because tenants do not repair fences in proper time, they quickly fall to ruin. The landlords then soon weary of fence building and the tenant has to patch up the old fence for another year.

This lease has no sliding-scale provision. One could be added to advantage that would adjust the $1,000 upward or downward according to the changes in the index number of prices received by farmers in his state, or better still, received in his type-of-farming area. About forty states now compute state-wide index numbers. A still better basis of

payments could be obtained if index numbers of both *prices received* and *prices paid* were made available. As pointed out earlier, this is now being done by type-of-farming areas in several of the states.[6]

STANDING RENT Standing rent differs from cash rent in that the landlord has to stand the shock of fluctuating prices along with the tenant. In the lower South prior to the war, the rule commonly followed was one bale of cotton per mule. This usually meant a bale of cotton per five acres of cotton. The additional land on the farm was used to grow feed for the mules, and what little livestock the tenant might have. Rarely was the tenant required to pay any of his feed crop as standing rent. The landlords tend to be rather indifferent about what happens to their farms as long as the tenant raises enough cotton to pay the rent. The tenant finances his own farm and living expenses. The landlord risks no operating capital, but he may have to reduce his rent if the cotton crop is almost a complete failure.

SHARE LEASES Probably the best developed type of share lease in this country is the stock-share lease found in the Midwest, especially on dairy farms. The commonest type is that in which the productive livestock on the farm is owned in common in equal undivided shares and the proceeds from sales are divided half-and-half, and likewise the productive livestock at the end of the lease. This is ordinarily considered a complicated type of lease, and so it often proves to be when it first comes into a new area. However, where it is well established, the landlords and tenants have learned how to operate under it, and customary procedures have developed which take care of the rest. The land is unusually well maintained under this lease, because the feed crops are fed on the farm, and a good share of the land is in hay and pasture or broadcast crops.

Following are some of the special provisions that indicate the nature of this kind of rental contract:

1. The landowner and tenant shall in common and in equal undivided shares own all cattle, hogs, poultry and sheep. Not less than twenty head of milk cows shall be kept upon the place at all times. *Livestock*
2. Each shall pay one half of all expenses (except labor) for threshing, silage cutting, feed grinding, twine, shredding, pasturing stock and veterinary bills (except those contracted for the tenant's horses). *Expenses*
3. Feed and fertilizer shall be purchased jointly, each party incurring one half of the expenses. *Purchase of feed and fertilizer*
4. Each party shall furnish one half of the seed for grain and annual hay crops. *Seed*

[6] Wisconsin, Montana, Washington, Idaho, Iowa, and Illinois.

Horses / *Colts* — 5. The tenant shall keep not to exceed ____ horses without the landowner's consent to keep more. The horses shall be fed from the undivided feed on the farm. No colts shall be raised without the consent of the landowner.

Taxes / *Insurance* — 6. The landowner is to pay the taxes on the land; the tenant is to pay the taxes on his own personal property, and the landowner and tenant jointly shall pay the taxes, insurance, and so forth on the property owned in common by them.

Crops and livestock / *Milk and cream* — 7. All crops and livestock products and the increase of all livestock shall belong half to each party, and the tenant shall pay one half of the proceeds from the sale of same to said landowner immediately upon receipt thereof. In the case of checks for milk and cream, the buyer shall make equal checks for each party and these accounts together with deductions for hauling shall be made each month.

Gardens, poultry and milk — 8. The tenant shall have sufficient garden space, eggs and poultry for family use. Any surplus shall be equally divided between landowner and tenant. The tenant shall have not to exceed one gallon of milk per day.

Division of stock upon termination of lease — 9. On the occasion of dividing the property at the termination of the lease, the tenant shall divide each class of stock, as cows, yearlings, calves, hogs, and so forth, into two groups and the landowner shall be given the choice of the groups. In case the groups cannot be made approximately even in value, as for example where there are odd numbers of animals, the difference in value shall be adjusted before the choice is made.

Silage — 10. The silage remaining on the farm at the termination of the lease shall be sold by the tenant to the landowner at an appraised value.

The management of such farms is also joint in large measure. A common provision is that "all policies as to management shall be whenever possible agreed upon by the contracting parties, but in case of failure to agree, the landlord shall decide." Some leases spell out certain restrictions with respect to management such as, "It shall be the plan to feed the cows when not on grass not less than one pound of grain for each four pounds of milk given." Similar provisions are made with respect to the cropping system.

Variants of this system are found in various sections of the country. For example, in the western part of the dairy area, the landlord may furnish all the productive livestock and receive one half of the receipts. This may be the first form which stock-share leases take when they appear in a new section — the landlords find it necessary to provide the herd if it is to be a productive one. In parts of the dairy area where farming is less well developed, the landlord may furnish everything and receive two thirds of the receipts. This arrangement may be made by a retiring landlord who wants to assist a young man without capital and is willing to leave all of his livestock and equipment on the farm.

The commonest types of share-renting arrangements on cotton farms

are the $\frac{3}{4}-\frac{1}{4}$ and $\frac{1}{2}-\frac{1}{2}$. In the first, the landlord may also receive a third of any grain or hay because this takes less labor than cotton. The share leases on cash-grain farms in the Midwest and on the Great Plains divide the crop in wheat in the same proportions, but the tenant gets the smaller fraction. In the commonest crop-share lease in North Dakota, for example, the tenant furnishes one fourth of the twine and threshing expense, and either the farm machinery or the horses, but not feed for them, and gets one fourth of the crop. Under the next most common type, the tenant bears half the twine and threshing expense, all the machinery and work horses, and feed for the work horses, and gets half the crop.[7] The crop-share leases in Minnesota range in order of frequency from $\frac{1}{2}$ to $\frac{1}{3}$ to $\frac{2}{5}$ to $\frac{1}{4}$. Only 12 per cent of the leases in Minnesota in 1936 were straight crop-share. The $\frac{1}{4}$ leases are most common in the Red River Valley, and the $\frac{2}{5}$ leases in the corn-growing area.[8] Paul Poirot found that the cash crops are normally shared half-and-half along with the dairy receipts on share-rented general farms in New York State.[9] In California, from two thirds to three fourths of the rented cotton, cash-grain, crop-specialty, and fruit farms are rented on shares, and around a third of the rented truck farms. The cotton tenant commonly pays only a fourth or a fifth of the cotton and meets all the expenses, including the irrigation water charges. The landlord's share on grain farms is usually a fourth, one fourth on hop farms, one third on rice farms, one fourth on truck farms, a third on orchards and a fourth on vineyards.[10]

SHARE-CASH LEASES Attention has already been called to the prevalence of share-cash leases in much of the Corn Belt and westward. In southwestern Minnesota, three fourths of the leases are of this type, and nearly half of all the leases in the state. These leases almost invariably call for the sharing of the small grain, and likewise of the corn in the dominantly corn-growing counties. Hay may be divided the same way in the northern half of Minnesota. The cash rentals cover the pasture, corn silage, and forage crops. In Clay County, Nebraska, Garey found four fifths of the leases on a share-cash basis.[11] The crop is likely to be divided on about the same basis as under crop-share leases. On

[7] Cap E. Miller and Willard O. Brown, *Farm Tenancy and Rental Contracts in North Dakota*, North Dakota Bull. 239, 1937.

[8] Minnesota Bull. 353.

[9] Paul L. Poirot, *Farm Tenancy in New York*, Cornell Bull. 483, 1942.

[10] California Bull. 655.

[11] L. F. Garey, George H. Lambrecht, and Frank Miller, *Farm Tenancy in Clay County, Nebraska*, Nebraska Bull. 337, 1942.

the share-cash farms in the Corn Belt, the tenant is likely to receive half the corn and two fifths of the soybeans and small grain, and to furnish all the power and machinery and seeds except grass and legume seeds. With the introduction of hybrid corn, many of the landlords are paying part of the seed costs to stimulate the use of hybrids.

SHARE-CROPPING LEASES Under share-cropping leases, as stated earlier, the cropper and the landlord divide all crops on an equal basis, and each contributes half of the variable costs. The cropper's half is his pay for the labor he furnishes. The landlord's half pays for the use of the land, equipment, buildings, mules, and repairs, and usually for financing the cropper's share of the operating expenses, and financing the needs of the cropper's family until the crop is harvested. In picking a farm for the next crop year, the cropper often gives as much consideration to the amount furnished as to the fertility of the farm. The landlord therefore risks the major part of the operating capital. The cropper risks one half of the operating expenses and assumes the risk of a change in crop yields and prices on his portion of the crop. Any benefits from additional efforts of the cropper, and from the management of either the landlord or the cropper, are shared between the two parties.

As generally recognized, the share-cropper system represents an alternative method of securing labor for owner-operators whose farms are too large to be handled completely by family labor, and who are unwilling to assume the risk of wage operation. Share-croppers generally make higher incomes than wage hands in periods of high prices, and less at other times. Also, as already pointed out, share-cropping decreased in the 1930's and then increased during the war, even though prices of cotton and tobacco were high. The cropper families were much more willing to continue on the same farm throughout the crop season if they had a share in the crops. Credit arrangements are usually much more favorable to the cropper when prices are good.[12]

The share-cropper system differs from other share-rent systems also in that the cropper does not usually operate a complete farm unit, but only a fixed acreage of cropland. The landlord considers his plantation or farm as a whole and fits the operations of each cropper into his over-all plan. The organization and income for a cotton-livestock farm operated with cropper labor in the Tennessee Valley in Alabama is shown in Table 75. This farm has eight cropper families sharing on a half-

[12] For a good discussion of these aspects of the problem, read E. J. Holcomb and G. H. Aull, *Sharecroppers and Wage Laborers on Selected Farms in Two Counties in South Carolina*, South Carolina Bull. 328, 1940; and J. G. McNeely, G. T. Barton, and T. R. Hedges, *Land Tenure in Arkansas*, Arkansas Bull. 438, 1943.

and-half basis in the production of 116 acres of cotton, sorghum for syrup, Irish potatoes, sweet potatoes, and the gardens. This farm had 374 acres in crops, but part of it was double-cropped with winter legumes and winter oats, wheat, and barley.

The croppers' share of the crops sold was $4,712. The landlord paid them $1,322 in wages for help on the other crops on the farm. After deducting the croppers' share of the crop expenses, the eight cropper families received $5,225, or $653 per family. By sharing a part of his crops with these cropper families, the operator had labor when it was needed for his other enterprises. If he could have hired the labor for his cotton on a wage basis in 1943, it would have cost him around $400 less than the $4,712 he paid as a share of the crops.

TABLE 75. ORGANIZATION AND INCOME, COTTON-LIVESTOCK FARM OPERATED WITH CROPPER LABOR, TENNESSEE VALLEY, ALABAMA, 1943

Crops

	Acres	*Yield per acre*	*Croppers' share, per cents*
Cotton — lint	116	340 lbs.	50
— seed		534 lbs.	50
Corn	110	40 bu.	0
Oats	(23)	11 bu.	0
Wheat	(10)	20 bu.	0
Barley	(20)	12 bu.	0
Lespedeza — hay	35	1 T.	0
— seed	10	250 lbs.	0
Sericea lespedeza hay	10	1.5 T.	0
Beans and peas — hay	55	.75 T.	0
— picked	18	10 bu.	0
Sorghum syrup	3	41 gal.	50
Irish potatoes	4	150 bu.	50
Sweet potatoes	2	100 bu.	50
Gardens	8	———	90
Winter legumes	(156)	———	—
Acres cropland	371	———	—
Acres crops grown	580	———	—

Livestock

		Croppers' share
Mules	3	0
Mares	4	0
Colts	7	0
Cows	10	0
Heifers	1	0
Sows	7	0
Pigs raised	66	0
Chickens	212	0

Gross income

	Prices	*Total receipts*	*Croppers' share*
Cotton — lint	18.7¢	$7,384	$3,697
— seed	——	1,550	775
Oats	$1.10	160	——
Barley	$1.50	38	——
Legume seeds	——	1,866	——
Irish potatoes	$1.20	240	120
Calves	——	270	——
Brood sows	——	189	——
Hogs	——	1,387	——
Poultry	——	538	——
Milk	——	1,021	——
A A A payment	——	623	120
Total receipts		$15,266	$4,712

Source: These data were supplied by Benj. F. Alvord, Alabama Experiment Station.

CHOICE OF LEASE

It may serve to bring out the differences between cash and share leases if we consider some of the reasons commonly given by landlords and tenants in different sections of the country for preferring each of them.

FROM THE LANDLORD'S POINT OF VIEW

Advantages of cash leases

1. Cash renting is less bother — landlords do not have to look after managing their farms and getting their share of the increase in livestock and of the products sold.
2. Much trouble and friction is saved between the landlord and tenant over managing the farm work, selling the farm produce, and dividing the receipts and expenses.
3. Landlords do not have to worry about their tenant's stealing from them or cheating them out of their full share of the farm income.
4. Tenants lacking in ambition are sure of a fair living under a share lease, since they get a large part of it from the farm, and they do not worry much about the regular field crops. As a result, the landlord gets a poor return from his land.
5. Landlords know in advance what they are going to get.
6. Bargains can be made more easily and more accurately in cash terms than in share terms. For example, in some sections landlords cannot afford to give tenants half of all the increase in livestock and sales of produce, and yet the custom of the neighborhood makes it impossible for them to rent for any other share than one half. Accordingly, they rent for cash.

Advantages of share leases

1. The landlord is able under a share lease to help manage the farm and make it yield a larger income for both him and the tenant than if the tenant managed it alone.
2. The landlord is able to look after his farm at share rent and keep a tenant from "skinning the land." Cash tenants feel they have a right to do as they please so long as they pay the rent.
3. In poor years, tenants cannot make their cash rent and the landlord loses part of it; but in good years, the tenant always gets the full surplus of the big crop.
4. The landlord who has a good herd of cattle is able to leave all or part of it on the farm, where it will yield both landlord and tenant a larger profit than the poorer herd which a tenant will bring onto the farm.

FROM THE TENANT'S POINT OF VIEW

Advantages of cash leases

1. Most tenants prefer to be their own bosses more than they can be under share leases. Many landlords are meddlesome and suspicious. Share leases offer too many chances for friction.
2. Many share tenants feel that getting only half the return for their labor is not enough when they do as good a job as they are otherwise inclined to do. They feel that if they do a thorough job, the landlord benefits more from their extra efforts than they do.
3. Many tenants want to be free to engage in enterprises entirely of their own, such as buying and selling livestock, feeding sheep or cattle, growing sugar beets, threshing, silo filling, and get all the profits themselves.
4. Most tenants want to keep their increasing capital in the form of livestock and equipment. When their herds get large, they want to rent a farm for cash and furnish all the livestock.

Advantages of share leases

1. Tenants who have not enough capital prefer share renting because it requires less. In fact, many of them could not possibly rent in any other way.
2. Tenants wanting to build up a herd of cattle like to rent a farm with a good herd on shares and get half the increase.
3. Some tenants, especially at grain farming, are glad to share the yield and price risks with the landlord.
4. Tenants just getting started sometimes desire the participation of the landlord in the management.

THE LENGTH OF THE LEASE

The number of years for which a lease is normally written is not in itself the major concern. It is rather the number of years that the tenant remains or expects to remain on the same farm. The term of the lease, however, does give some assurance to the tenant and he is more likely to plan his program with a view to remaining for a longer period. The facts as to the duration of occupancy of tenants in this country, presented in Table 76, are startling, and reveal the greatest weakness in the tenant system of the United States. A fourth of the white croppers, and nearly a fifth of the Negro croppers had moved within the last year, and around a seventh of the cash and share tenants. The Negro croppers are somewhat more stable than the white croppers. Only around two

fifths of the cash and share tenants had remained on their present farms five years or more, and 31 per cent of the Negro croppers and 22 per cent of the white croppers.

TABLE 76. PERCENTAGE OF FARM OPERATORS ON PRESENT FARMS FOR DIFFERENT PERIODS, OWNER-OPERATORS, CASH TENANTS, SHARE TENANTS, SHARE-CASH, AND CROPPERS, SEPARATELY, 1940

Period	*Owner-operators*	*Cash tenants*	*Share tenants*	*Share-cash*	*Croppers*	
					White	*Negro*
Less than 1 year	3	15	14	12	26	18
1 year	5	17	16	14	21	18
2 years	5	13	12	11	14	14
3 years	5	10	10	10	10	10
4 years	5	7	8	9	6	8
5–9 years	16	19	19	21	14	18
10–14 years	14	9	10	11	5	7
15 and over	48	9	11	13	3	6

The practical choice is between a short lease arranged so that it can be renewed readily, and a longer lease arranged so that it can be terminated easily. Landlords can get rid of objectionable tenants under long leases as well as under short ones provided the leases contain satisfactory termination clauses, but not without settlements to make. The landlords do not always realize the heavy losses from year-to-year tenancy because they come gradually. Provisions for controlling the crop rotation and the sale of crops and for regulating the amount of livestock kept only partly reduce these losses. Besides, one-year tenants cannot pay as high rent as three- and five-year tenants. It is in the second and third years, after they know their farms and neighborhoods better, and are able to grow better crops and livestock with less labor and expense, that they make the largest incomes.

The best practical lease for most farming is probably a 3- or 5-year lease with provisions for renewal, termination, compensation for disturbance and for unexhausted improvements, and for adequate settlement by arbitration or otherwise at the end of any year or in case of breach of contract. At the end of five to eight years, most tenants are likely to be looking for a larger or better farm to rent, or for a farm to buy, or the farm may have to be sold to settle up the estate. In England and Scotland, 19- and 21-year leases were long advocated, but they were abandoned after a hundred years of experience with them. Even

restrain the tenant unduly, he will manage to get around it somehow. On the other hand, if some understandings are not stated definitely in the lease, and the tenant subsequently objects to carrying out the wishes of the landlord, and the matter is taken to court, the tenant may win because the custom of the community has set up a precedent that supports the tenant.

This raises the question as to whether leases should be written. Most of them are written in the Northern states, but in some Southern states less than 10 per cent of them are. The major reason for a written lease is that then the arrangements are more likely to be carefully considered by both parties and the terms defined with greater precision. The written lease also serves as a memorandum to both parties so that the actual terms of understanding cannot be forgotten. Also, in the case of the death of either party, the written contract protects the estate from false claims by the other party.

Some landlords object to written leases, however, saying that they give the tenant an advantage because the tenant has little or no property to back up such an agreement whereas the landlord has. Actually, however, an unwritten agreement is just as binding as a written one. The principal difference is that if it is unwritten, the custom of the community more nearly determines what the terms are. Written leases can be more flexible than unwritten, and with agriculture changing rapidly these days, it is often important to depart from the custom of the community. This may be illustrated by a recent case in which a tenant asked compensation from his landlord for maintenance of terraces that had been installed during the period of the lease. The landlord refused and the tenant sued and collected compensation. In another, the tenant obtained compensation in court for fences and terraces that he had built without obtaining consent of the landlord.

In many communities, the exact legal status of landlord-tenant contracts is not clearly established by law or custom. They may be interpreted as partnerships, in which case the landlord may find himself responsible for debts which the tenant has incurred for feed or fertilizer. This uncertainty is avoided in many cases by a specific statement that the contract is not a partnership, but simply "an agreement to work land," and by avoiding the use of the terms landlord and tenant or lessor and lessee in the contract. With such an agreement, the tenant cannot dispose of any of the products of the farm without the owner's consent and no one else can attach them.

Disputes between landlords and tenants frequently arise at the time of termination of the lease. Many of these can be avoided if a written

inventory is made of the equipment on the farm at the beginning of the lease, and written statements or records are made of subsequent transactions that may call for settlement at the end of the lease. Many leases also now provide for settlement of disputes by arbitration committees chosen from the community. Such provisions are highly desirable in most cases.

A majority of the disputes that arise between landlords and tenants result from minor details. The tenant may keep a larger flock of poultry than the landlord thinks is reasonable, or may keep a small flock of turkeys that may not have been mentioned in the lease. Since the women of the family take care of the poultry, they feel rather strongly that it belongs to them. Or perhaps a heifer is injured beyond recovery because of some neglect of the tenant, or a barn door is blown off because it was not closed before an approaching storm. The successful landlord manages to bear with such minor adversities, and to keep his eyes focused on the main chance, which is helping his tenant increase the output of milk from the herd, or the yields of the cotton or wheat. The landlord who can help the tenant increase the farm income, and hence the tenant's share of it, and thus promote the tenant's progress in accumulating resources with which to buy a farm of his own, is likely to have very little difficulty with his tenants.

Finally, putting the house in livable condition when a new tenant family moves in, looking after needed repairs in the house, and providing a good garden for the family, with orchard and small fruits in sufficient supply, has a very salutary effect upon the attitude of most tenant families.

FURTHER READING

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EXERCISES

1. What percentage of the farms in your county are rented? What percentage are rented to tenants who are related to the landlord?
2. What are the common terms of farm rental in your home community? Do you think these are fair to both landlord and tenant? If not, why? Do they tend to prevent the most profitable operation of farms? If so, how, and how could this be avoided?
3. If you were going to rent a farm in this community, what terms and conditions would you seek to get? If you were a landlord, what would you seek in a tenant and what terms and conditions would you offer him?

CHAPTER XXXI

The Farm Business of Selling and Buying

IN THE OPENING CHAPTER OF THIS BOOK, THE SELLING OF THE PRODUCTS of the farm and the buying of supplies, equipment, and livestock, as done by farmers, were presented as together constituting one of the major phases of farm management. Succeeding chapters frequently called attention to the selling and buying problems of particular systems of farming, but did not stop to analyze any of them. This chapter will undertake to present the general principles involved in the management of selling and buying by farmers, and then make some applications to the systems of farming already discussed. The chapters in PART FIVE dealing with cotton, wheat, fruit, dairy, poultry farming, and the like, will consider marketing along with production.

On the farm, buying comes first in time before selling. But selling will be considered first in this book because farmers seem to be more concerned with their receipts than with their expenditures. Actually, buying is about as important as selling. To be sure, the receipts are larger than the expenditures — otherwise farmers would have no net incomes. But low net farm incomes probably are due about as much to poor buying as to poor selling.

THE MAJOR POLICY ISSUE

The first major decision which a farmer has to make on the selling side is how much of the marketing of his product he will do himself, how much turn over to middlemen by selling at the farm, and how much he will have done for him by a cooperative. At one extreme, he can deliver his product to consumers direct, as the producer-distributors of milk do, and many producers of strictly fresh eggs around our cities; also a few who sell from roadside stands or by mail order. At the other extreme, some orchardists sell their crop on the trees. Many livestock producers sell to buyers who call at the farm. Between these extremes are the farmers who deliver their produce to retail stores, or to commis-

sion merchants or dealers, or to processing plants, all within hauling distance, or offer it for sale at auction or from stands in public markets.

When farmers sell cooperatively, they delegate the selling of their product to the hired managers of the cooperatives which they and their neighbors have organized and whose operations they control. From the standpoint of the farmer member, selling cooperatively is much more like selling to a dealer than it is like selling direct to processors or wholesalers. Nevertheless, if a cooperative is to be really effective, the members must work closely with it and keep fully informed concerning its operations. The cooperatives, of course, have many of the same choices as the individual farmers. They may sell at public auction in a large city wholesale market, or sell direct to smaller operators in the smaller cities scattered over the country. They may even set up branch distributing houses of their own in the larger cities. Cooperatives are likely to go farther into the central market than farmers. In fact, the major reason for setting up many cooperatives has been to enable the farmers to reach farther toward the consumer. *This chapter, however, is not going to deal with the business management problems of cooperatives as such.*

Farmers have somewhat the same options on the buying as upon the selling side. They may buy from local merchants or from mail-order houses, or direct from other farmers or from manufacturers. Cooperative buying has expanded greatly in the last twenty-five years, and some of the cooperatives are now doing a good deal of mixing of feeds and fertilizers and of other processing.

The processing and marketing of some farm products cannot be clearly separated. This is well illustrated by developments in the marketing of dairy products. Farmers once processed their milk into butter and cheese on their own farms and exchanged it for groceries at the local stores. Homemade butter is still being sold from stands in public markets in most of the cities of the South. Later, most of the milk was processed in local creameries and cheese factories. Still later, most of the farmers in butter-producing areas separated their cream at the farm so as to save hauling. The creameries were able to standardize methods of making butter and to produce a better product than was made on the farm. In the 1920's, many of the cooperative creameries in the United States federated to form central marketing cooperatives that could reach farther toward the consumers. At the start, the Land o' Lakes cooperative did much of its selling to chain stores and hence did not reach the consumers who were ready to pay top prices for it. Then it set up branch houses in the larger cities, to supply butter directly to jobbers, hotels, and restaurants.

Always some meat is slaughtered on farms and sold direct to households; or in the South, in public markets. A few farmers make special products like jellies, preserves, and pickles, for sale at roadside stands, or in stalls in public markets. In general, however, the individual farm is too small a unit for processing. If farmers are to do processing, they need to do it cooperatively, as in the case of creameries and cheese factories. Cooperative meat-packing plants have not prospered in this country as in Denmark, but a number of canning cooperatives are operating successfully, handling such products as cranberries, cherries, and olives. Possibly in the future, small quick-freezing units will be operated successfully on relatively large farms or by small cooperatives. If so, they may be able to supply local markets with *local* supplies of small fruits and vegetables the year round. Quality control, however, is a major factor in the success of quick freezing, and local processors may not be able to compete with the large companies on this score.

The more of marketing and related processing that is done by farmers themselves, or in near-by towns and cities, the more work is provided for farm people, and the more the employment in rural towns and cities. This could be one way of reducing under-employment in rural areas. If agriculture cannot find a market for more of its products, perhaps it can sell its products in more finished form, or carry them farther along in the marketing process. For reasons of this kind, Mr. D. Howard Doane, of the Doane Agricultural Service, is urging such a development, referring to it as "vertical diversification"; and Mr. Cason J. Calloway of Blue Springs Farms, Hamilton, Georgia, is emphasizing "processing plants near the farms," and production of products lending themselves to local processing, as one part of his "Plan for Georgia Agriculture."

From the standpoint of farm management, the decision as to how much of the marketing to do — buying is here understood to be as much a part of marketing as selling — is mainly a matter of how much time and energy is given to marketing as distinguished from production. Does it pay best to concentrate almost wholly on production, or to divide one's energy and time between production and marketing? If the latter, how divide it — enough time to marketing to be a good member of a cooperative? or enough to sell to dealers in a public market? or enough to process and sell to retailers? or enough to reach the final consumer directly? Clearly no one rule fits all situations. Location near a small city may make selling to retailers pay best, and location near a large city may make selling to dealers best. A farmer combining dairying with apple production may sell his milk cooperatively and his apples to

a jobber. Much depends upon the marketing ability of the particular farmer. He may have capacity for management, but not for the marketing type of detail. Many farmers are good at managing production but not at managing buying and selling. Ability to buy and sell is usually referred to as "business" ability. It is *one kind* of such ability. It may contribute as much to the success of a farm as knowing how to feed cows, or control late blight of potatoes, or organize the farm production. Selling and buying need large inputs of management. They reward much attention to details. A farmer with little capacity for management will find it best to let others do much of his marketing.

The size of the farm business may be a major determinant on individual farms. If a farmer has too few acres to provide full employment for his family labor force, or for an extra hired man whom he needs part of the time, he may do more marketing as one way of providing fuller employment. A farmer hard put to it to look after his production is likely to sell in whichever way requires the least of his attention.

The range of adjustments between production and marketing to obtain a total farm business of the desired size is rather wide. One farmer may haul all his fat cattle and hogs a hundred miles to market. Another may sell to a local buyer and devote his resources to feeding a few more cattle or hogs, buying the feed if necessary. One farmer may operate a stand in a public market, and another choose to rent additional land or even work at a part-time job off the farm. One dairy farmer may choose to operate a milk route and another to buy additional feed and milk more cows, or raise more heifer calves, or enlarge his poultry enterprise, or grow a few acres of vegetables or small fruit for the local market.

The farmer's decision in such a matter may not be rational, but based on personal preference. The inclination of some farmers runs toward concentrating on their production, and of others toward business dealings of one sort or another. It has long been noted that men with urban backgrounds or traditions who find their way into agriculture are more likely than others to turn their attention toward dealings in livestock, collecting poultry and eggs, operating roadside stands, and sometimes even in dealing in used and worn-out machinery and parts.

Some types of decisions as to the extent of marketing are aided by setting up budgets of probable receipts and expenses for the various alternatives. Thus, a farmer considering whether or not to organize an egg route as a way of receiving better prices for his eggs may estimate on the basis of the best information at hand that he can get 12 cents more per dozen from consumers direct than selling his eggs to dealers,

this being about the usual spread between consumer and dealer prices, and that he will need to use his truck, making weekly deliveries, 2,500 miles a year at a cost of 4 cents a mile. Selling 3,000 dozen per year, he would have a margin of $260, or about $5 per day, as compensation for his extra labor. This extra $260 could well be worth his extra effort if he could spare the time for it.

The long-time trends have, of course, been leading away from farmers' doing their own marketing. With less self-sufficiency in agriculture and more production for the market, more marketing specialists have appeared. This is merely one phase of economic specialization or division of labor. The usual assumption of economists is that specialization is always better and cheaper. But, in fact, it needs to be tested in each case. We need to make sure in each situation in agriculture that employing marketing specialists reduces, if not the real costs of getting food from producers to consumers, the combined costs of producing and distributing it; that the farmer uses his time and effort better producing more for the market than in bothering with the details of selling the product; that by concentrating on production he can lower his production costs or increase his income enough to offset and more what he might earn from further attention to marketing.

The data on expansion of commodity distribution as a whole for this country are given in Table 77 — it is not possible to separate farm products from other products in this particular comparison. They show an amazing increase since 1870 in the fraction of our workers engaged in buying and selling and related transportation and storage, and an equally amazing decrease in the fraction engaged in production. The decade 1920–1930 was one of particularly large decrease in the fraction engaged in production. Part of the increase for distribution is because family living has become less self-sufficing; families buy much more of their food, clothing, fuel, and household goods at the store than they did in 1870, and the foods now consumed are transported longer distances — fresh vegetables and fruits from California, Texas, and Florida, for example. Also the larger the city, the more the cost of supplying it with food. The "services" group includes teaching, health, amusement, and police and other public services, as well as domestic service.

Included in this shift, so far as agriculture is concerned, has been whatever increase has occurred in cooperative buying and selling. The 1940 census showed that 1,043,000 farmers were buying and/or selling cooperatively, as compared with 625,000 when the first census of farmer cooperation was taken in 1920. The number selling cooperatively increased 60 per cent in this period, and the number buying coopera-

tively, 125 per cent. The total membership of all the 10,450 cooperative associations in the United States in 1943, including considerable duplication of membership, was 3,850,000. Their total volume of business in 1942–1943 was $3,780,000,000, of which over four fifths was selling.[1]

TABLE 77. NUMBER OF GAINFUL WORKERS IN PRODUCTION, COMMODITY DISTRIBUTION, AND SERVICES PER THOUSAND OF THE POPULATION, 1870–1940

	Production	*Distribution*	*Services*
1870	251	39	44
1900	251	74	58
1920	248	92	61
1930	216	106	77
1940	204	110	84

Source: Based on Table C, Appendix, *Does Distribution Cost Too Much?* The Twentieth Century Fund.

The multiplication of services and resulting increase in costs has not affected all classes of commodities alike. Data on food costs alone are available only since 1913. In 1913–1915, the farmers were receiving $123 for a consumer's market basket of food, and the middlemen and transport agencies were receiving $147 for getting it into the consumer's hands. In 1937–1939, the farmers were receiving only $126 for this same market basket of food and the middlemen were getting $196. This was an increase of 35 per cent per food dollar. Chart 91 presents these same figures graphically in the form of percentage of the consumer's dollar received by the farmer. This figure averaged 46 per cent at the beginning in 1913–1915, and only 40 per cent in 1938–1940. The percentage rose at the onset of the two world wars and then declined sharply afterwards. The general trend in the farmers' share has been definitely downward. It is costing the consumers more to have their foods distributed with the increasing commercialization of agriculture and the expansion of middleman services.

Illuminating in this connection are the differences in the spreads on individual foods shown in Chart 92. They are highest for the highly processed foods like bread and macaroni, and next highest for canned goods. They are lowest on meat products, poultry and eggs, and dairy

[1] Statistics of Farmers' *Marketing and Purchasing Cooperatives*, Farm Credit Administration, U.S.D.A.

products. Factors other than processing that account for the differences in spreads are volume and frequency of sales to consumers, and resulting turnover, size of the individual consumer's purchase, the amount of packaging required, waste and losses, and the amount of other services sold with the product. Retailers' losses on fruits vary from about 8 per cent for oranges to 24 per cent for peaches, and from about 3 per cent for potatoes to 24 per cent for cabbage. In many cases retail margins are not closely related to costs; some products are carried because consumers are more likely to trade at the store where they can buy them.

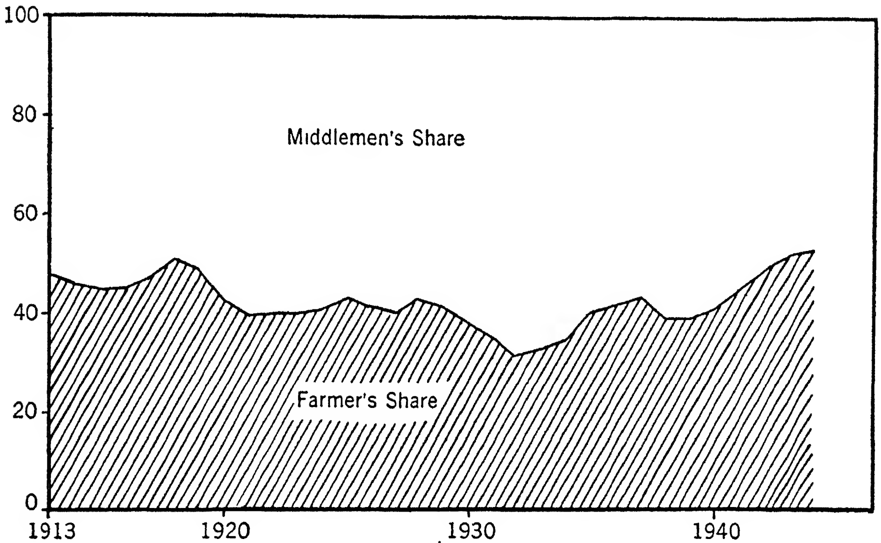

CHART 91. The farmer's share of the consumer's food dollar. (Based on Table 1, *Agricultural Outlook Charts*, U.S.D.A., Bureau of Agricultural Economics, November, 1944.)

Furthermore, separate costs of retailing the numerous items sold from a grocery store cannot really be determined — any cost figures purporting to do this are faked in large measure. The relative retail markups are traditional in part. Independent grocery stores are still relying where they can upon high margins on coffee, tea, and spices to compensate for low margins on some other products.

WHAT TYPE OF PRODUCT

A well-managed farm needs to follow a planned sales program that includes what type of product to sell, for what market, when to have it ready for the market, and when to sell. If this program can be based on

a careful study of markets and marketing, combined with a certain amount of testing out of different possibilities to discover how they work, it can be the best possible program for the farm. The selling and production programs need, of course, to be closely coordinated — so closely coordinated, in fact, as to be really one program.

Many farmers are impatient with trying to fit their production to markets. They are disposed to condemn the markets and the middlemen when they do not pay them good prices for whatever they choose to produce or have been in the habit of producing. They may even go so far as to insist that they are entitled to "cost of production" for their products no matter what the state of the market. They are even reinforced in this belief by some businessmen who tell them that, "Of course the farmers are entitled to cost of production." What we are concerned with in this chapter is the effect of this attitude of farmers on the type and quality of product they choose to produce and on the condition in which they offer it for sale. Many products can be offered for sale on a field-run basis without any sorting whatever, or they can be carefully sorted and graded and even selected for size to fit different consumer uses. Such sorting and selecting involves additional labor and expense, but it also brings higher prices. Altogether too many farmers, because of their attitudes, fail to realize upon opportunities to increase their incomes by putting a graded product on the market.

Decisions in this matter can be analyzed rationally. The costs and prices can be balanced against each other to see whether the additional income covers additional costs and leaves enough over to make the additional labor worth while to the farmer and to members of his family. To illustrate, a producer of strawberries for a local market was once urged by the retailer whom he was supplying to sort his strawberries after picking in the field, offering as an inducement 2 cents extra per quart box. It took 2 cents, however, to cover the 10 per cent of the strawberries that were culled out, so that nothing was left for the additional labor. When the merchant raised the margin to 3 cents, some of his customers would not pay the difference. The merchant and the farmer persisted, however, and in the third year the strawberry sales of this merchant broke all previous records.

Decisions on such points commonly require reaching back to the producing stage. Apples may need to be thinned more carefully in order to have a high enough proportion of well-shaped and highly colored specimens. Tomatoes may need to be staked in order to obtain a product that will bring a fancy price.

One of the defects of the marketing system is that in spite of all the

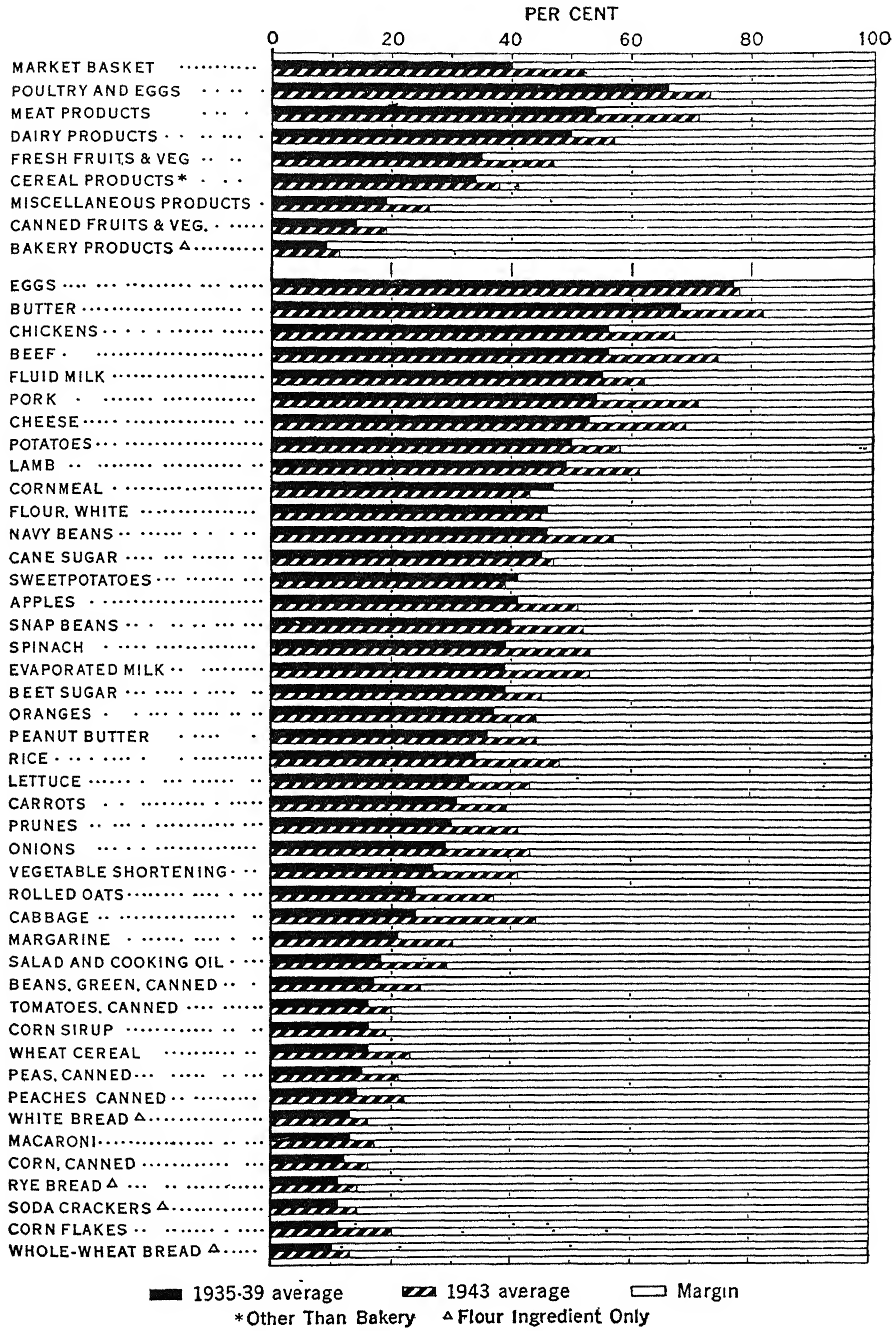

CHART 92. Percentage of the consumer's dollar received by farmers, for selected foods and groups of foods, 1935–1939. (*Agricultural Outlook Charts*, 1944, p. 18.)

developments in market grading, and the quoting of prices by grades, it frequently fails to reflect back to the producers all that the consumers are willing to pay, and sometimes do pay, for a better quality of product. The consumers may actually at times be paying twenty cents a bushel more for potatoes that have been carefully handled and sorted, but particular growers who have delivered a high quality of product may have received little for their extra labor because their potatoes were thrown into a car along with others in much poorer condition. Eggs produced from farm flocks have especially suffered from this defect of marketing. Only if eggs are candled and graded when delivered is the individual producer paid for them according to their market value. Most consumers are ready to pay a sizable premium on bacon and ham from hogs that are fed a bacon-type ration rather than a lard-type ration, but unless a local packing plant has developed an outlet for such a product, the farmers selling hogs of this type may get little in the way of a premium. The large packers may sort out the bacon-type carcasses and sell them in the British export trade or in a special home market, but the producers themselves may share only a little in the higher prices received.

The full content of this problem of quality in the product can be excellently illustrated by the marketing of the Maine potatoes, whose production was considered so carefully in Chapter VII.[2] Often from 10 to 15 per cent of the tubers are crushed or bruised in the harvesting and in subsequent marketing operations. The injuries begin with the machine digging. In the haste that arises from picking potatoes on a contract basis, many are bruised in getting them into the barrels; and the handling from there on into the warehouse may be fast and rough. Other damage results in the sacking of the potatoes and in their handling after they are sacked, in loading and unloading from trucks and cars at the shipping end or within the central market. A grower can place such stress on keeping down all the costs of digging, picking and handling that an unusual amount of such injury occurs. Or he can carefully supervise all these operations, select workers who are careful in handling the potatoes, or train workers to handle them properly. Customary practice tends to rule in such matters, but the market demands change.

Related to tuber damage are the sorting, grading, and packaging operations in potato houses. These can be done carefully or recklessly. The requirements for U. S. No. 1 potatoes are that not more than 6 per cent be defective tubers, and not more than 5 per cent smaller than

[2] This discussion is based largely on *Marketing Maine Potatoes in Maine and in Boston* by Gordon W. Sprague. Farm Credit Administration, U.S.D.A. Bull. 51, 1941.

$1\frac{7}{8}$ inches. If the potatoes as they leave the warehouse in Maine just come within these tolerances, they are likely to exceed them when they reach the receiver in the large city, or particularly when they reach the consumer. In March, 1940, in 320 bags of Maine potatoes examined in retail stores in Boston, 39 per cent of the bags had $2\frac{1}{2}$ per cent or more of the potatoes showing old bruises; 26 per cent, mechanical injury; 9 per cent, disease; 3 per cent, dry rot; and 9 per cent, new bruises.

For this and other reasons, Maine was supplying only a fourth of New York City's potatoes just before the war as compared with a half or more before 1930. This type of problem cannot be solved satisfactorily by the individual grower unless he is a large enough producer to have his own brand and develop his own sales outlets in a comparatively large area. If he does a more careful job of handling and grading his potatoes, he will not get much of a return for it as an individual producer if his potatoes go through the usual channels of trade. Some of the chain-store organizations have solved this problem in part by buying directly from the growers according to specifications and paying enough of a premium to make it advantageous for the grower to meet these specifications. Maine Potato Growers, Inc., a cooperative organization of the larger growers and shippers, is making progress with this problem by supervising, grading, sorting, and handling of the small fraction of the crop which it sells. Collective action is called for in a situation of this kind. It can either be cooperative or be provided by government. No government program thus far adopted for this has proved to be adequate.

WHEN TO SELL

For a nonperishable crop like wheat or corn or cotton, the decision as to when to sell is merely one of whether to sell at harvest time, or to hold for a possibly more favorable market later in the year, or even in the succeeding year. For fresh vegetables, the decision involves production as well as marketing — the production may be planned to reach the high-priced early market, the main season, or the late market. The range in varieties of peaches is so wide that they can be ready for market over a period of a month or more in most areas. Eggs and poultry production can now be timed to put the product on the market at any season of the year. Marketing of beef cattle, hogs, and lambs have their seasons, but still a considerable range is possible. In each case, the decision needs to combine the seasonal variations of prices, the yields from production at different seasons, and the costs of producing at different seasons. The farmer must put all these factors together and work out a

program of production and marketing that promises year in and year out to yield him the largest net return. The production part of this analysis must take account of the way in which the production fits into the year's program of work. New Jersey has a place in the New York and Philadelphia potato markets because of its ability to mature a crop before the principal late-crop states start. Massachusetts, by planting onion sets in place of seeds, reaches the New York market ahead of the regular crop.

Chart 93 shows the average seasonal range in corn prices in the Chicago market for the period 1921–1940, and also the movement of prices in 1936 and 1937, the first a year of extreme drouth and expanding demand, and the second a year of high production and business recession. If a corn grower bases his selling program on the average seasonal movement, he will come out at the end of the ten years at the same place as if the seasonal movement were like the average each year — that is, provided the seasonal range remains the same in the next ten years as in the last. Such a program is usually considered "safe and sane." If economic conditions change much during the ten years, however, the seasonal pattern may be changed importantly, and the farmer will need to know about this and modify his program accordingly. His agricultural extension service should be on the watch for such shifts and call them to his attention. It should also be borne in mind that in particular years the farmer following this plan will gain or lose considerably. For example, he would have gained in 1937 if his plan had called for selling his corn early in the year, but would have lost in 1936.

The opposite policy is to attempt to forecast the years when the price is going to rise or decline more or less than the average and to vary the selling program accordingly. Many thousands of market operators have tried to make their fortunes guessing the market in this way, and a few of them have succeeded. It is not likely that many farmers will be shrewder in guessing the market than traders who make it their one business in life.

Nevertheless, something of a middle course between these two extreme policies is likely to be best. Some major differences between years can be recognized and allowed for. Prices of most farm products follow certain patterns from year to year as well as within the years. G. S. Shepherd has illustrated this very well by showing the varying course of prices of corn in the years following big and small crops (Chart 94). Apparently in years following big crops, the carry-overs depress the price during the first four or five months, and not until the stocks are fairly well used up does the price start upward. Then when it does

recover, it rises more rapidly and in a more sustained manner than in other years. The decline in the price of corn from August on in years after small crops may reflect the impact on the market of oncoming crops which promise to be larger than the average.

In the case of hogs, it would seem as if the hog producer should be able to increase his income if he could adjust his production so that it

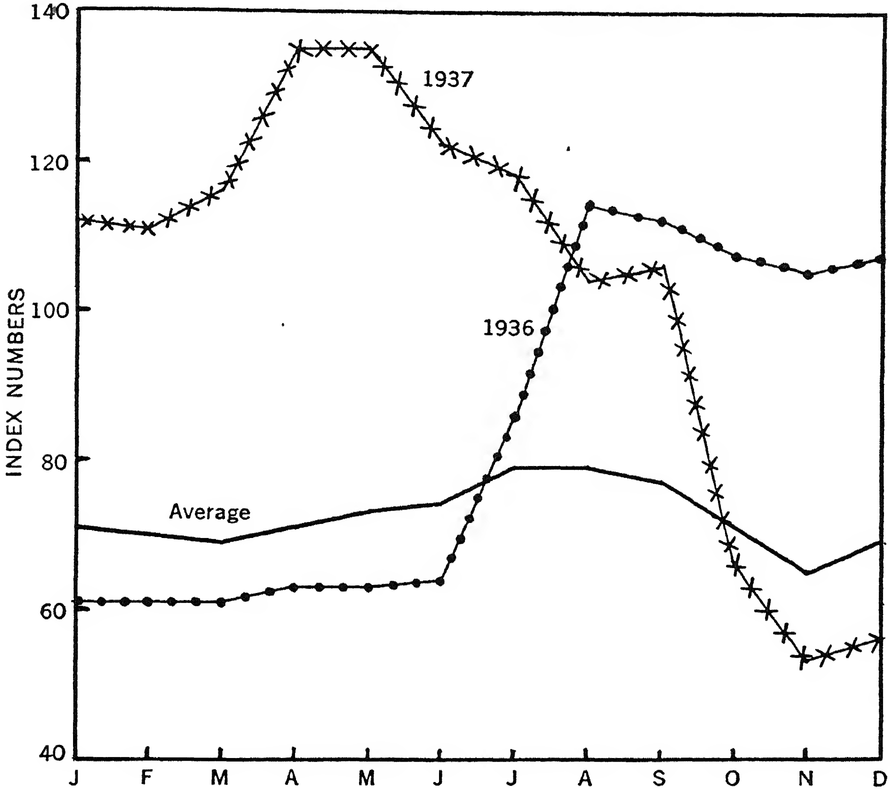

CHART 93. Average monthly variations in corn prices 1921–1940, and 1936 and 1937, No. 3 Yellow Corn, Chicago. (Index numbers; average = 100.)

ran opposite to the movements of the hog-corn cycle shown in Chart 69. In the years when hog production is on the upturn of the hog-corn cycle, the increasing farrowings in the spring depress the market in the fall, with the result that fall prices are lower than the spring prices, whereas in the downturn of production, the reverse is true. If the hog farmer could only break away from the crowd and have his heavy farrowings when his neighbors have light farrowings, he would benefit greatly from so doing. Furthermore, if enough farmers broke away along with

him, a regular seasonal movement would develop on the basis of which hog producers could plan much more dependably than now. Many hog farmers are trying to plan their programs in this way, but apparently they are not finding it easy. Unfortunately, as pointed out in Chapter XX, the size of the corn crop also determines the marketings, and it probably affects the farrowings also. R. M. Green and E. A. Stockdyk found, as one would expect, the seasonal price increases much sharper

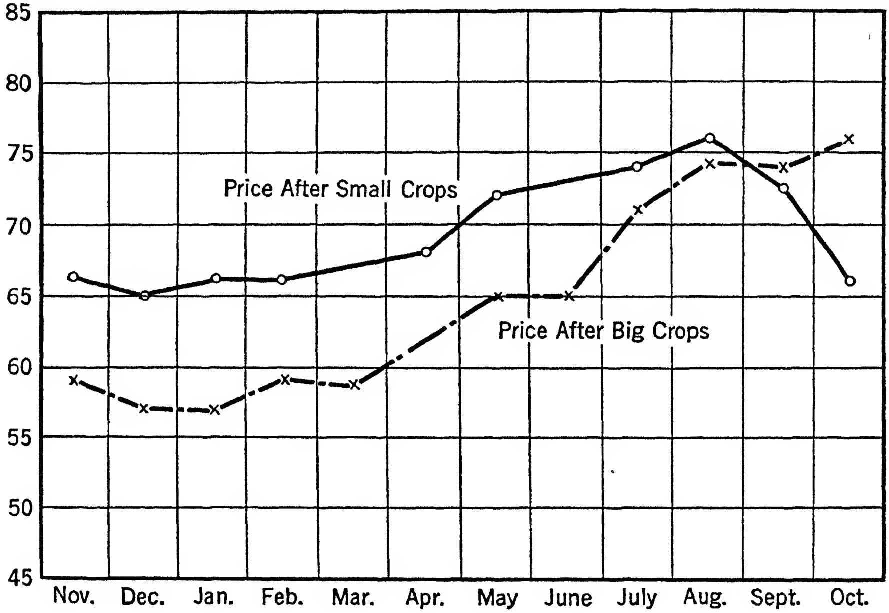

CHART 94. Monthly variation in prices of corn in years following large and small crops, 1900 to 1928, excluding war years, No. 3 Yellow Corn, Chicago. (Index numbers; average = 100.) (Reproduced from Iowa Circular 113, by G. S. Shepherd, p. 10.)

following small crops than following large crops, on the upturn of the hog-corn cycle, and the decreases somewhat more on the downturn.[3] This analysis made it clear that on the downgrade of the hog-corn cycle, the hog producers ought to get their fall-farrowed pigs to market not later than April, and preferably in March, and that on the upgrade of the hog-corn cycle, May is a better month than April or March. It is particularly important to get them to market in September and October on the years of upgrade in the hog-corn cycle.

The widest annual seasonal range in prices of staple farm products

[3] Kansas Circular 137.

appears in the case of *eggs*. The broken line in Chart 95 shows the seasonal range for the years 1921–1935, and the solid line the range for the more recent period 1938–1941. The movement of egg prices breaks roughly into three periods. From August until early winter, prices rise sharply, reaching a peak in November or December, at which time eggs from nearby henneries begin to move in volume into the New York market. The decline continues to a low point late in February. Prices remain low from March through to June. The peak of receipts is usually

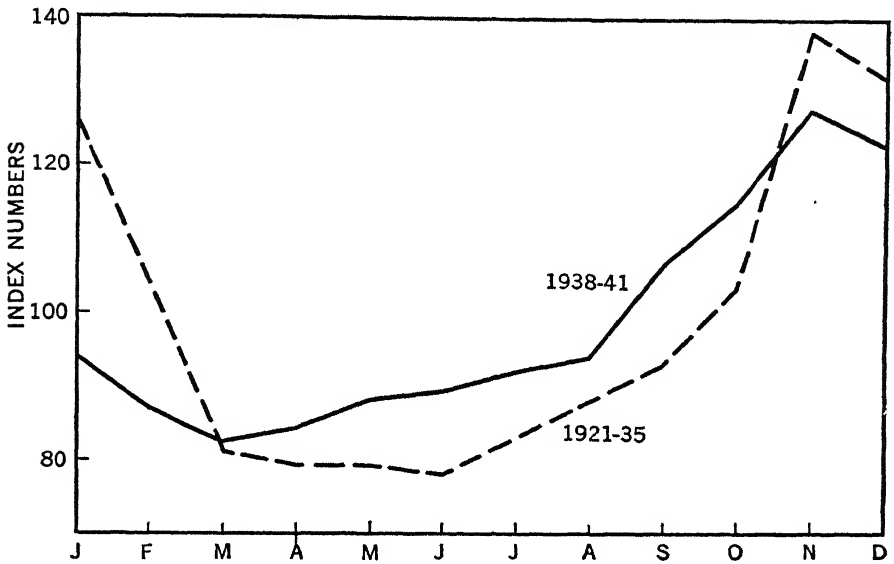

CHART 95. Monthly variations in egg prices, 1921–1935, and 1938–1941, New York Firsts. (Index numbers, average = 100.)

in April, and by June a definite decline in receipts has set in. The low point in receipts is in November. Storage stocks are lowest in February and increase until July or August. Because of the wide fluctuations in production, a large volume of eggs is stored. The seasonal range has declined gradually over the years as a result of improvements in the processing of eggs for storage and because of increased production of eggs in the fall and winter. Also, a decade ago, a large proportion of the fresh eggs in the New York market in October through November came from the Pacific Coast. At present, new methods of production have enabled the nearby producers to supply most of the market needs.

Chart 96 shows the general upward movement of *potato* prices in years of short as well as of large crops. The prices appear to advance

definitely more in years of short crops than of large crops. This difference seems to be correlated with the disposition of farmers to market a larger fraction of their crop in the first part of the season in years when prices are high and supplies relatively low, than when the reverse is true. They move many more cars of potatoes to early market when they have a large crop than when they have a small one, but still not enough of them. A potato grower has the option of disposing of his

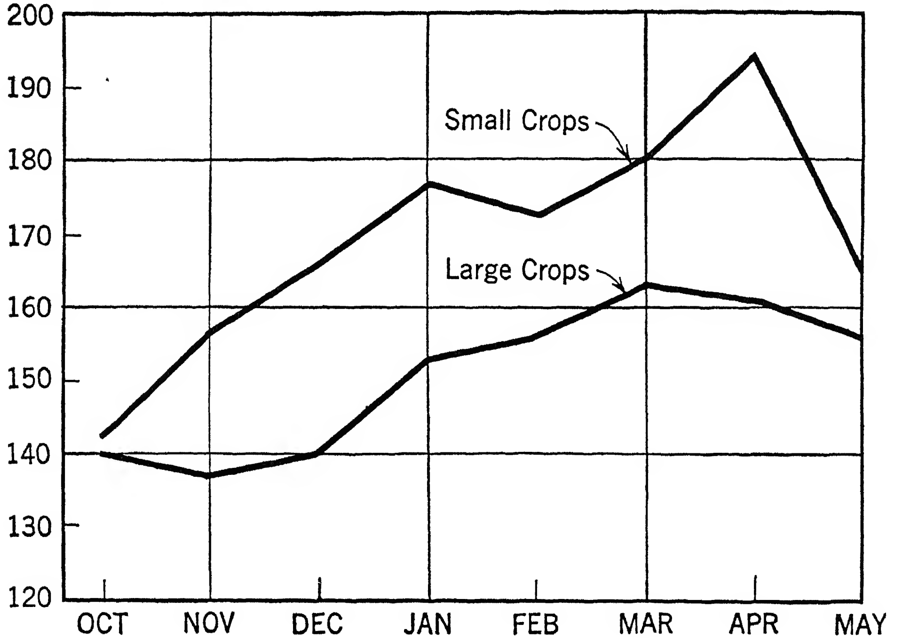

CHART 96. Monthly average prices of potatoes, five years of short crops and five years of large crops, excluding years affected strongly by general price movements, 1921–1940, Chicago wholesale carlot prices per barrel. (The period is too short to furnish a safe guide for action. It can serve only to illustrate the principle.)

crop at harvest time, or of putting it into storage and preparing it for the market at any time during the succeeding six or seven months. The sorting and grading is best done immediately after the rush of the harvesting is over. If the potatoes are marketed soon thereafter, however, the warehouses will be empty most of the time. The potatoes need to be stored somewhere, and farm storage may be more economical than shipping-point or central-market storage. No doubt some fairly regular storage program is in general best suited to conditions in particular areas or on particular farms. To settle upon such a program and adhere

to it year after year is probably better for most growers than to try to judge the market and to hold in some years and not in others. The latter calls for closer knowledge of marketing conditions than most individual potato growers are likely to have. An intermediate policy, such as suggested for corn, has possibilities, however, for growers able to give the necessary attention to it.

If forecasting the market is fraught with dangers with a perishable annual crop, obviously it is still more hazardous with nonperishable crops like *cotton* or *wheat* that may be carried from one year to the next in the hope that the next year's crop will be short. Most calculations that indicate an advantage in carrying over the excesses of large crops are misleading. Single pairs of years can readily be found in which it would have paid well to have done so — if too many other farmers had not done the same thing. There are more years in which the cost of the carrying would have been larger than the gains in price.

Of course, if the government wishes to offer "loans without recourse," that is, make loans in which it takes most of the possible losses and gives the farmers most of the possible gains, it may well prove advantageous to farmers to carry over an unusual part of their crop. The value of such a program from the standpoint of the nation is outside the scope of this book.

The carrying of a reserve of *feed crops*, like hay, oats, or corn, from one year to the next, and making this reserve larger in years of good crops than in years of small crops, may have much more to recommend it than carrying reserves of wheat and cotton, because it makes possible a more stable livestock program. Following such a program, the farmer does not need to reduce his breeding herd when he has a short crop, just at the time when his less provident neighbors are obliged to do so. He is therefore likely to be in a position to continue or expand his production at the time when they must contract, and to receive higher prices year in and year out in consequence.

JUDGING PRICES FROM SUPPLY

Farmers as well as traders may make use of the method of judging whether prices any year or season are too high or too low by comparing them with prices in other years when the supply was the same. This method can also be illustrated with potatoes. Chart 97 relates production in the 31 late-crop states, reduced to a per-capita basis for the years from 1919 to 1940, to the wholesale price of those years, expressed in 1926 dollars. With production around 2.5 bushels per capita, the price

has averaged around 80 cents per bushel in 1926 dollars; and with production around 2.2 bushels per capita, it has averaged around $1.20 per bushel. Within this range, the demand for potatoes is highly inelastic, that is, the price rises sharply as supply declines. With more than 2.5 bushels per capita, the opposite is increasingly true.

Now if all the points in this chart lay exactly on the curve in the chart, and this curve fits the future as well as the past, one could tell in advance that the average annual price would be 75 cents as soon as one knew that the production was in the neighborhood of 2.6 bushels per capita. All one would have to do would be to note the production on the horizontal scale, 2.6 per capita, draw a line like AB to the curve, and another one like BX across to the vertical scale to obtain the price 75 cents per bushel. Of course, one would still have the job of converting this average price into monthly prices. This could be done by using the average of the monthly variations for large, small, and intermediate crops of other years. A table might be made up something like Table 78.[4]

TABLE 78. YEARLY PRICES BASED ON CHART 97, WITH SEASONAL VARIATIONS BASED ON CHART 96

Production per capita	*Yearly prices*	*November prices*	*February prices*	*April prices*
Small crops				
2.1	$1.45	$1.35	$1.48	$1.67
2.2	1.20	1.12	1.22	1.38
2.3	1.03	.96	1.05	1.18
2.4	.91	.85	.93	1.05
Intermediate crops				
2.5	.82	.75	.84	.91
2.6	.75	.69	.76	.83
2.7	.68	.63	.69	.75
2.8	.63	.58	.64	.70
Large crops				
2.9	.59	.54	.61	.63
3.0	.55	.50	.57	.59
3.1	.52	.47	.54	.56
3.2	.49	.45	.50	.52

But *the points do not lie exactly on the curve*, nor on any other curve that may be drawn. In fact, they lie farther from it than appears at first glance. The distance away from the line must be measured *vertically*,

[4] The seasonal distributions are based on Chart 96. Again the reader must be cautioned that these data are merely illustrative.

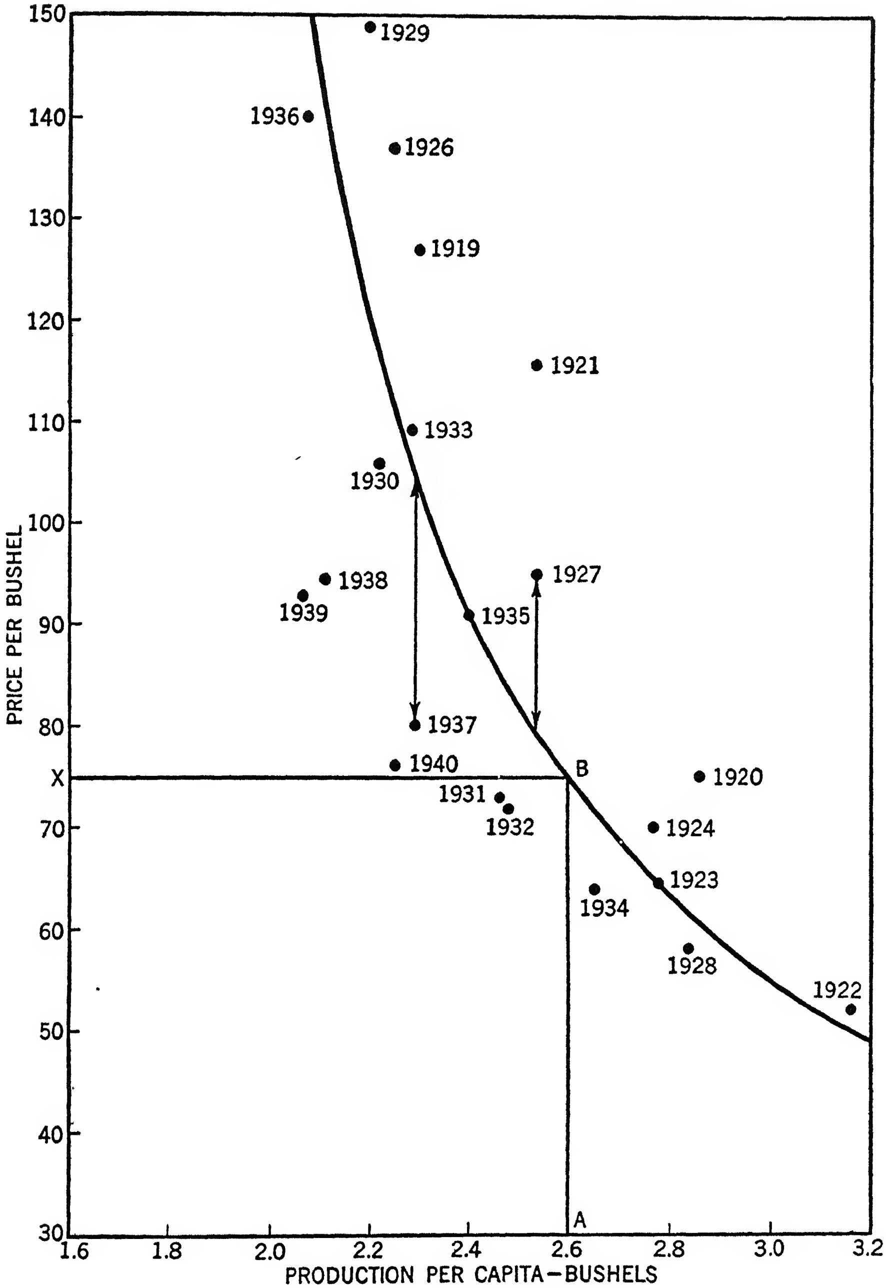

CHART 97. Variation in prices of potatoes, in dollars of 1926, with production per capita.

as indicated for the years 1927 and 1937. Actually the prices in these two years were, respectively, 15 cents higher, and 23 cents lower, than they would be if all the points were on the curve. Below 80 cents per bushel, however, the fit is somewhat better.

Finally, the prices so obtained would need to be changed from the 1926 level to that of the current year and month, and this is a further cause for error, since none of the available price level series fits this purpose well, neither the Bureau of Labor Statistics wholesale price series, nor the Bureau of Agricultural Economics agricultural price series, nor any other that can be named. The B L S series was used in making the chart and table.

Surely we must conclude from this analysis that even in the case of a crop like potatoes whose supply-price relationships are unusually regular, we can judge only roughly the level of prices from supply. It is somewhat more difficult with cotton and corn and hogs, and much more difficult with wheat.

If the individual farmer without subsidy from the government is more likely to lose than to gain by holding a perishable crop like potatoes until the later part of the season, in order to gain from a possible pronounced rise in prices such as sometimes occurs, and also from carrying the excess of large nonperishable crops over to later years, how about the cooperatives which are set up by the farmers to sell their products? The facts are that in the past the cooperatives have lost more often than they have gained by pursuing such policies. More often than not, they have chosen the wrong years in which to hold their product off the market. The reason for this is that they are inclined to do this in the years when prices at harvest time are disappointingly low, which are thus low because of factors in the general marketing situation that are reflecting themselves in the market but are not generally recognized. Reacting in this way, the potato cooperative that went into operation in Minnesota in the fall of 1922 when the crop was large, advanced more to its growers than the crop finally sold for and was closed out in one year. The grain pools that held wheat off the market in the fall of 1929, because the price was disappointingly low, were on the eve of a break in prices that continued until 1933, but they did not recognize that a break was occurring even though its impact was already being felt in the market. The cotton cooperatives had an equally disastrous experience in 1929–1930.

The gains from cooperative marketing are mainly of other sorts — from economies in local market operations, from savings in transportation and storage, from quality control, from improved grading and sorting,

and the like. Frequently the gains from these have been largely wiped out by the losses from trying to hold up prices in years when prices were low at harvest time.

BUYING PROGRAMS

In many ways the market in which the farmers buy is more difficult than that in which they sell. In the first place, there are more elements of imperfect competition in buying than in selling markets. When the farmer goes into the market to buy a truck or tractor or farm machine of any kind, he will find no dearth of dealers each one prepared to convince him that his particular make of machine is better than any other that he might buy; but few dealers who will, openly at least, reduce the price to make a sale. If a transportation company operating a fleet of trucks was in the market for a year's supply of new trucks, it would write out its specifications as to design and performance and ask for bids from competing manufacturers. The individual farmer cannot do this.

It will also be remembered that farm machinery prices fell off very little during the Big Depression — certainly not more than a fifth — whereas farm products fell off more than a half. When sales slacken, manufacturers of farm machinery and similar items slow down their production and hold their prices, whereas most farmers keep on producing. This difference does not make the manufacturers monopolists. No conspiracy among them is needed to keep farm machinery prices from declining at such times. It is the nature of their business to follow such a course of action, and in the nature of agriculture to do the reverse. Often, however, there will be combined with the foregoing a type of behavior, which is described technically as either "monopolistic competition" or "imperfect competition," a familiar form of which is the *price leadership* which the larger firms furnish the smaller ones. The smaller firms find that they can make more money by selling what they can at the prices set by the larger firms than by cutting prices, for if they start cutting prices the larger firms may outbid them.

Farmers are helped in their buying of feeds and fertilizer by government regulations which require specifying on the sack the percentage of different ingredients; and similarly with seeds. But the information given is not sufficient in many cases. The brand names under which these and other supplies are sold are ordinarily of not much help because there are so many of them, and frequently the brands which are most heavily advertised are not those of first quality. The farmers cannot

test the different brands individually, and public agencies do not announce the result of tests by brands. The procedure at one of the agricultural colleges of painting a board fence along the roadside with different brands of paint and letting the public see that some of those for which the highest claims were made in their advertising were those which peeled first, has not been adopted by very many institutions depending for support upon the good will of the general public.

It may be pertinent to remark in this connection that although nature may produce a wide variation in type and quality of products, she does not set out deliberately to confuse those who buy her products.

Finally, farmers buy a large variety of products mostly in small lots and they cannot spend much time learning the facts concerning each of them. Only a small fraction of the information which farmers need about supplies and equipment is ordinarily available. The experiment stations have not begun to do enough testing along these lines. A large organization such as a chain store, or a hotel system, has a staff of purchasing agents and skilled buyers.

The increase in cooperative purchasing in the last two decades noted earlier has occurred mainly because the buying associations have managed to overcome these handicaps to a greater or lesser degree. The associations have expanded most in the sections of the country where they have been most successful in overcoming these disadvantages. Chart 98 shows wide regional differences in the extent of cooperative buying. The large selling cooperatives of California also buy supplies for their members. They are able to buy in volume, and discriminatingly. So are the Illinois Agricultural Association and other similar units in the Midwest, and the Grange League Federation and the Eastern States Farmers' Exchange in the Northeast. These associations not only employ skilled purchasing agents, but they may mix their own feed and fertilizers. They do no advertising, and pay for little of it in what they buy. Noncooperative business is finding it necessary to adopt similar methods in order to compete with the cooperatives on even terms. The growth of cooperative buying is restricted in the South by the inability of many farmers to pay cash for supplies on delivery.

Farmers are fortunate if they have a choice between a strong private merchant and a strong cooperative in the same or a near-by market. If such competition is absent, prices may get out of line temporarily in some markets. To illustrate, the farmers around a community in the Midwest found themselves at one time paying more for lumber and feed than their neighbors. Some of them started getting bids on lumber from surrounding towns and hauling it as much as twenty miles. The

two local merchants shortly began to meet these bids, but they still took advantage of the farmers near to town who were willing to pay a little extra rather than to haul the longer distances. The final step was the setting up of a local unit of a state buying organization affiliated with one of the farm organizations. This quickly brought prices down to the level of that of the surrounding towns, and one of the local merchants sold out to the other.

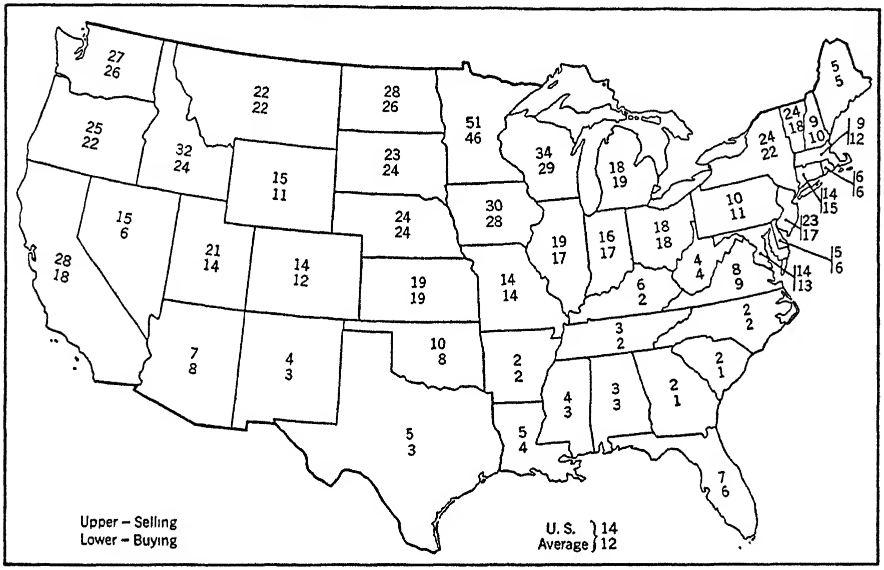

CHART 98. Percentage of farmers selling and buying cooperatively by states, 1940.

Two final observations about buying in general: The first is that farmers who depend upon sizable purchases of particular supplies such as of feed, fertilizer, or packaging materials, are frequently able to save on the price by buying considerably in advance of needs. The dealers are able to offer slightly more favorable terms because it spreads their business more evenly through the year. The second point is that in practice farmers do a vast amount of improvident buying. This is especially true in areas where incomes are highly irregular, such as in the high-risk areas of the West, or in specialty areas like some of the tobacco districts. A flock of automobile and other salesmen watch these areas like harpies and descend upon them the moment that the returns come in from highly favorable crops.

Farmers are buying services as well as commodities these days — telephone service, electricity, medical and hospital care, testing services,

etc. Frequently there is a choice as to type or quality of service. The telephone service can be a simple rural line that connects the farmers in the community and gives toll service with a nearby small city, or it can be full service that puts the farmers in contact with the whole country. As more and more of the telephone services have come to be of the latter sort, the cost has risen to a point where fewer and fewer farmers now have telephone service. It is doubtful if the improvement in the service has not been carried on too rapidly in many areas.

Rates for electricity need to be furnished according to a schedule that encourages fuller and fuller use of available electric power. In general and until recently, the suppliers of electricity have not recognized how great is the elasticity of its demand and how a combination of making equipment available at low prices and reduced rates for additional power uses will reduce the cost per unit. With a proper schedule of rates, farmers can use more and more electric power to advantage.

ADVERTISING OF FARM PRODUCTS

The use of advertising as an aid to selling farm products and increasing the income from their sales was strongly advocated during the period of surpluses in the 1930's, and many attempts were made to increase consumption of farm products by advertising. Some of these undertakings were conducted under public auspices: for example, the advertising of oranges, grapefruit, and tangerines by the Florida State Department of Agriculture; of potatoes, by the Maine Development Commission; of apples, by the Washington State Apple Advertising Commission; and of milk, by the New York State Department of Agriculture.

These were attempts to increase the consumption of a particular farm product, at the expense of some other farm products, except as consumers could be induced to spend more of their income for food. In some cases, any increase would have been at the expense of competing regions. None of the analyses of the effects of this advertising enables one to say whether the advertising was effective or not. Claims have been made, but in all cases other factors more reasonably account for any increases in sales over prior periods that appeared; and sales did not always increase. For example, the sales of Maine potatoes were less the first year of the advertising than during the year before; likewise the sales of Florida tangerines.[5] The advertising may have contributed

[5] A. F. Wolf, "Measuring the Effect of Agricultural Advertising," *The Journal of Farm Economics*, May, 1944.

to an increase in sales, but the data cannot be made to show it truthfully.

The advertising done by large-scale cooperatives has a much longer history. It has been connected with standardized brands and combined with nation-wide sales programs designed to build up popular acceptance and demand for such products as Sunkist oranges, Sunmaid raisins, and Diamond walnuts. It is difficult in these cases also to isolate the effect of the advertising as such. The standardization of the product has probably contributed more than the advertising, but the two are necessary complements of each other. Without larger sales, it would not be profitable to grade more closely and discard part of the product; and without improving the product, the advertising would be ineffective. Such advertising has cumulative effects over the years and cannot be judged in the short run.

Over the years, however, other factors are likely to contribute much more than the sales program. This is clear from the data in Table 79, which compare the acreages in 1919 and 1939 of the principal vegetables and fruits consumed in this country. The largest increases are for vegetables that have been advertised scarcely at all, like lettuce, young carrots, spinach, asparagus, and green beans, and the smallest increases are for staple products like cabbage and onions. The large increases have been due to increased consumption of winter-grown vegetables, to an increase in canning, to a general rise in consumer incomes and increased ability to buy more varied diets, to a shift toward lighter diets as the population has become more sedentary, to improvements in transportation and marketing methods, and above all else, to strong public programs of consumer education. These developments have made fresh vegetables more available in stores in small country towns and in cities and to farm families in surrounding territory.

The number of trees of most orchard fruits decreased from 1919 to 1939, due largely to the disappearance of trees from farm orchards. The commercial sales increased, although not at all strikingly. There has been a shift toward the citrus fruits, but how much of this is due to advertising, and how much to the factors already listed, especially to the making of citrus fruits available to larger circles of consumers, and how much to the strong emphasis in public education on the values in citrus fruits, is impossible to determine. The increase in consumption of oranges has been very little greater than that of tomatoes, and tomatoes have had very little advertising. Cranberries, which have been heavily advertised, have increased somewhat less than citrus fruits and no more than strawberries, tomatoes, and celery. Improvement of transportation

and marketing have no doubt figured largely in an increased consumption of cantaloupes, lettuce, and the like.

TABLE 79. ACREAGE, OR NUMBER OF TREES, OF FRUITS AND VEGETABLES, 1919 AND 1939

Vegetables	*Acreage*	
	1919	*1939*
Asparagus	30,200	116,800
Beans, green	72,000	231,200
Brussels sprouts	984	4,188
Cabbage	124,000	166,300
Cantaloupe	78,400	141,500
Carrots	6,500	55,000
Celery	20,100	36,500
Corn, sweet	271,600	402,400
Cucumbers	51,600	79,100
Lettuce	21,300	121,700
Onions, dry	64,300	112,400
Peas, green	103,700	296,300
Spinach	10,000	69,300
Tomatoes	316,400	517,500
Watermelons	159,100	306,300

Small fruits	*Acreage*	
	1919	*1939*
Cranberries	16,800	18,500
Raspberries	50,300	59,000
Strawberries	119,400	175,200
Tree Fruits	*Number of trees or vines (thousands)*	
Oranges	19,700	37,200
Grapefruit	3,100	11,000
Lemons	3,735	5,450
Apples	151,500	71,700
Cherries	14,500	12,200
Peaches	87,300	68,900
Plums and prunes	29,800	24,800
Grapes	253,100	291,900
Avocados	115	1,000

It is safe to conclude on general grounds that the total merchandising efforts of the large-scale cooperatives have increased the consumption of their products relative to the consumption of other fruits, but it is impossible to determine how much of the increase is due to advertising as such. It may well be that the orange-juice machine on the drugstore counter has done more to increase the consumption of oranges than all of the advertising.

A third and highly effective type of advertising is that of temporary large supplies of perishable fruits and vegetables at the peak of the season in local markets. When such advertising lets the consumers know about the low prices at which the product is then being sold, it may well result in the disposal of all of the crop at a price that is somewhat remunerative when otherwise some part of it would not even pay to harvest.

Finally, advertising by individual farms or local cooperatives in local markets, when combined with a program of standardization and quality improvement, may establish a growing and secure local market for the product of that enterprise. Such advertising can take various

forms, such as marketing the product, informative labeling on the package, or advertising on trucks and on farm billboards.

LOCAL TRANSPORTATION

The transportation of farm products and supplies to and from markets within local hauling distance may be done by the farmers themselves, still by wagon on many Southern cotton and tobacco farms, by automobile trailers on many farms, and by motor trucks on one farm in six in 1940; or it may be done by commercial truckers or by local buying agencies. Besides the 1,047,000 motor trucks on 944,000 farms in the United States in 1940, around 3,500,000 farms also had a total of 4,144,000 automobiles that were used to haul more or less farm produce to market or supplies from market. But in the principal commercial-farming regions, more farm produce is hauled by commercial truckers and buyers than by the farmers themselves. Let us consider the management problems connected with such transportation in terms of several typical situations.

THE CORN BELT Only one farmer in six in the Corn Belt had a motor truck in 1940. Livestock farmers find it generally better to hire their trucking done, the reason being that livestock trucks are specialized vehicles not suited to hauling other products. The commercial haulers get much fuller use out of such trucks than can most individual farmers. Aside from their use within the farm, the motor trucks in the Corn Belt are used mainly for hauling grain to market, or milk or cream to factories or condenseries, or bringing feed, fuel, and fertilizer to the farm. More grain farmers and dairy farmers have trucks than beef-cattle and hog farmers.

A study made of the use of trucks on central Indiana farms out from Indianapolis in 1939 showed an average annual cost of $200 per truck traveling 4,000 miles.[6] For half-ton trucks traveling the same distance the cost was $150, and for one-and-a-half ton trucks, $250. The trucks were actually in use on 200 days a year, but half of this time was spent in work on the farm. Only a fourth of the mileage, however, was within the farm — the trucks stand idle at the end of the field a good deal of the time.

Even the farmers owning trucks hired a fifth of their tonnage hauled, and dealers hauled another eighth of it. Farmers with trailers and no trucks, in contrast, hired about half their tonnage hauled, and a sixth

[6] T. K. Cowden, *The Use of Farm Trucks in Marketing Farm Products in Central Indiana*, Purdue Bull. 443, 1939.

of it was hauled by dealers. The trailers carry so much smaller loads than the trucks that they make more trips necessary. On a relatively large farm, this may mean more total cost than operating a full-sized truck. On the other hand, the costs of hauling the frequent small loads on many farms are less with a trailer than with a large truck.

The prevailing rates for hauling livestock to the Indianapolis market range from 6 cents per hundredweight for distances up to 10 miles, to 18 cents for distances up to 80 miles. The hundredweight rates for hauling grain range from 2 to 3 cents per mile for hauling up to 10 to 15 miles.

Did it pay the farmers in this area to own trucks? The conclusion of the study was that three fourths of them did not save enough in hauling hire to pay for their trucks, but that probably two thirds of the remainder got enough additional farm use from them to warrant having them. The method of analysis followed was reasonably valid. The cost of hiring the hauling done can usually be estimated fairly accurately, and so can the truck expenses for gasoline, oil, service, depreciation, insurance, and taxes. Many of the farmers who will appear to be operating trucks at a loss according to such figuring, however, will decide to operate them because of their convenience and of the time saved in getting to and from the fields. Some of them keep down the size of the investment in a truck by making over an old automobile body.

PALLET BOARDS WITH TRUCKS A development during the war in the West, borrowed from the Army and Navy, consists of loading lugs of fruit, sacks of grain, and the like, on strongly braced pallet boards that will hold several tons, and transferring these from trucks to larger road trucks, and to the unloading platforms of warehouses and canning factories, by lifting apparatus in trucks, so that the only manual labor involved is the first loading on the pallet board and the final unloading. The additional investment is mainly in the lift trucks.

TRUCK AND FRUIT FARMS IN THE NORTHEAST [7] The census shows that three farms out of ten in the Northeast have trucks. Dairy, fruit, vegetable, and poultry farmers are likely to be on the road more often than Corn Belt farmers, either hauling produce to market or hauling feed, fertilizer, and empty crates back to their farms. Most of their hauling, however, is for rather short distances. Trucks owned by growers are not used very much for long-distance hauling. The growers do not like

[7] Based upon M. P. Pasmussen, *Some Facts Concerning Means of Transportation and Methods Used in Marketing New York State Fruit and Vegetables*, Cornell Bull. 697, 1938

to drive more than fifty miles when they go to market; they hire commercial truckers for longer hauls. They haul only 3 per cent of their vegetables more than 100 miles in their own trucks. Even the commercial trucks do not haul produce very far — only 10 per cent of it more than 150 miles in the five Northeastern states studied. Appreciable tonnages of lettuce, however, are hauled between 100 and 150 miles, and considerable sweet corn, dry onions, broccoli, asparagus, and brussels sprouts are hauled 60 miles or more. Fruits are hauled somewhat longer distances than vegetables.

The trend in the Northeast seems to be toward an increasing use of trucks and less shipment by rail. The growers prefer trucks because of faster and more convenient service, because they provide store-door delivery, and because they consider them cheaper in the end.

A study made of nine hundred New York state growers showed that 70 per cent of the tonnage of fruits and vegetables was disposed of at the farm or at country shipping points, mainly to country dealers, but also to merchant truckers and buyers from large cities. The growers delivering their own crops to terminal markets are tending to act as their own salesmen. But many of them do not have an adequate knowledge of daily market supplies, and the kind of marketing sense needed, with the result that prices have become more erratic than they were before trucking developed. Part of the reason for this is that no methods have been developed yet for reporting expected arrivals of fruits and vegetables by trucks, and the growers have no way of judging when they reach the market what the price is likely to be. A further result is that on some days the terminal markets are highly congested and on other days not.

MILK AND CREAM The problems of transporting milk and cream to large cities are much the same everywhere. Boston can be taken as one example. Prior to 1935, most of the milk and cream for the Boston market was trucked to local receiving stations and thence shipped to Boston by rail. By 1939, half of the milk and a fourth of the cream was coming in by truck. Also by that time a fifth of the truck hauling was in tanks. Truck shipment saves in loading, unloading, container, and icing costs. It offers special advantages for off-rail plants.

The problems of transportation from dairy farms to receiving stations are much more involved. The hauling rates do not vary greatly according to the distance from the station, partly because the trucks may collect milk near to the station on their way out and haul it over the whole route before they get back, and partly because the competition with

competing receiving stations is likely to be stronger the farther from the station. The farmers near to the station, however, have the alternative of hauling their own milk, or of combining with a few of their neighbors and using a small truck, and this sets an upper limit on the charges to the near-by farmers. Many farmers are therefore in a position to make a decision between one of two or three methods of getting their milk to the plant.

Also, some of the hauling is done by the buying distributors, and hauling charges are combined with the price of the milk in such a way that the two are not really separate. Unless there is vigorous regulation, the hauling charges may also be juggled as a method of attracting milk away from a competing distributor. This kind of competition is likely to be especially important farther out from the receiving station. Individual dairymen with a large supply of good quality milk may in effect get it hauled for nothing. This kind of competitive situation forces the dairymen to bargain closely over hauling charges.

FURTHER READING

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EXERCISES

1. Describe, for each major product on your home farm, the method of selling — the point at which the sales are made, the usual terms of sale other than price, the agency to whom or through whom sold, and any other pertinent items. What alternative methods of sale exist for each product? Why is the present method preferred?
2. For some major agricultural commodity of your home county, construct charts showing normal seasonal variation in prices at the nearest organized market. How much variation is there from year to year in the seasonal pattern of prices? How safely can the average seasonal variation be relied upon in planning a production and sales program for a particular year?
3. To what extent do farmers in your community change their farming plans from year to year on the basis of expected changes in prices? On balance, do they gain by so doing?
4. What alternative methods of buying farm supplies are followed in your community? Why these differences?

CHAPTER XXXII

Financing the Farm Business

We now come to what is considered by many who have watched agriculture closely over the years, to be the poorest managed part of the farm economy, namely, the management of its finances. On one hand, a million or so of farmers in some years employ borrowed funds on untimely or ill-considered ventures; and on the other, almost any year fully as many, because of lack of capital and the fear of going into debt, or because they do not recognize their opportunities, fail to engage in ventures that would increase their incomes and well-being.

A large factor in the financing of any venture on borrowed funds is the risk involved. Agriculture is subject to a wide range of hazards, only part of which are now generally insured. This phase of the financing of agriculture is also inadequately developed.

For the shortcomings of agricultural finance, the credit agencies are fully as responsible as the farmers. At times, they loan too freely and recklessly, as, for example, in 1918–1920; and at other times, too cautiously. Generally, they play the role of waiting for farmers to come to them and ask for loans and then saying "Yes" or "No," instead of exploring the possibilities of increasing the earning power of the agriculture of their areas and helping the right farmers to develop farm plans and use credit effectively. Of course many of them are not competent to help develop farm plans, but they can usually call upon the agricultural extension service or other agencies to furnish this help.

The basic principle to be observed in all considerations of the use of credit is *that the lack of it should be allowed as little as possible to stand in the way of any undertaking or course of action that is otherwise good, and that ready access to funds should as rarely as possible lead to ventures that otherwise are not warranted.* This principle applies to each individual farmer as well as in the aggregate and nationally. Interest rates need to be taken into account as well as other cost-rates in determining the relative economy of undertakings using capital. It is important that the capital resources of society be allocated to the most productive uses. They

need to be economized in the same way as resources of labor and management. But once an undertaking proves upon analysis to be economically feasible, it should not be strangled by the lack of credit. Neither should it be prosecuted merely because credit is easily obtained.

THE SIZE OF THE JOB

All in all, the financing of the operations of agriculture is an undertaking of large magnitude. The total investment in farm enterprises in 1940 consisted of the following:

Farm real estate	$33,642,000,000
Machinery and tools	3,065,000,000
Productive livestock	3,351,000,000
Workstock	1,202,000,000
Annual cash outlays [a]	3,740,000,000
Total	$45,000,000,000

[a] Not counting in the labor and management of the farmer and his family.

It is customary in agriculture to refer to the last four of the above items as *working capital.* A more precise term is *movables,* that is, the parts of the farm enterprise which are not ordinarily sold with the farm, and are moved from farm to farm by cash tenants.

TABLE 80. CONTRIBUTORS OF THE LONG-TERM CAPITAL FOR AGRICULTURE IN 1940

	Owner's equity (millions)	*Mortgage debt (millions)*	*Ratio of debt to value*
Owner-operators:			
Owning no additional land			
Full owner	$7,930	$2,290	22.4
Part owner	3,637	822	18.4
Total	11,567	3,112	21.2
Owning additional land			
Full owner	4,249	848	16.6
Part owner	584	238	29.0
Total	4,833	1,086	18.3
All owner-operators	16,400	4,198	20.4
Landlords	10,588	2,456 [a]	18.9
	26,988	6,654	19.8
Owner-operators	$16,400,000,000	49 per cent	
Landlords	10,588,000,000	31 per cent	
Mortgage-holders	6,654,000,000	20 per cent	
	33,642,000,000	100 per cent	

[a] Based upon 1935 data. No data collected in 1940.

How much of the long-term capital of agriculture is furnished by operators, how much by landlords, and how much by mortgage-holders, is reported for the United States as a whole in Table 80. It appears that these three groups in the order named furnish this capital in about the proportions of 50, 30, and 20 respectively for the country as a whole. The census makes a separation between the owner-operators with loans only on the farms which they are now operating and those who also own other farms or land which are mortgaged. For the country as a whole, one of these groups is about as much mortgaged as the other, and the landlords carry about as much mortgage debt as the owner-operators. This suggests that a good many landlords are stretching their financial resources in order to own land as a source of income; or that they have mortgaged their farms in order to raise money for other ventures. One would not expect retired farmer landlords to have mortgages in most cases.

Chart 99 shows these same percentages by individual states. The contribution of mortgage-holders runs as low as 10 or 11 per cent in several of the South Atlantic states, and as high as 31 to 34 per cent in Wisconsin, the Dakotas, and Nebraska. The three grain states in this group had in 1940 just passed through a period of severe decline in land values because of drouths. This had the effect of reducing the owners' equities in their farms. Dairy farming in Wisconsin had also experienced some reverses in the same years. Wisconsin, however, has always been a state in which ownership under mortgage has been preferred to tenancy. Illinois to the south, in contrast, has only about half as large a percentage of mortgage debt, and this same description fits the Corn Belt states to the east. The Pacific Coast states follow the national average closely. The Northeastern dairy states have about the average proportion of mortgage financing, and the rest of the Northeast runs heavily toward owner-operator financing. The South has relatively little mortgage debt — its landlords largely finance the ownership of their land.

The total of outstanding short- and intermediate-term loans on January 1, 1943, not including store credit and that furnished by implement dealers, fertilizer companies, livestock firms, landlords and other private lenders, was around $3,160,000,000. This looks like an unusually large fraction of the $3,740,000,000 of annual cash outlays given above. This is because it includes a large amount of what is ordinarily referred to as *intermediate credit*, that is, *credit for periods running for more than one year and less than the usual period of a real-estate mortgage*, for the purchase of livestock, machinery, and the like, and also for land improvements and small buildings, which ordinarily cannot be paid for in one year.

Part of the $3,160,000,000 outstanding in 1943, moreover, was provided for definitely on a longer-term basis. In the extreme case, the Rural Electrification Administration loans, then totaling $345,000,000, now run for 35 years. The $400,000,000 of Farm Security Administration loans are ordinarily made for 5 years. The only common description that fits this block of working capital loans is that they are *not secured by farm real-estate mortgages*. The usual security, if any, is some form of a chattel mortgage. In the analysis which follows, a distinction will be made between loans to cover annual expenses of production, and ordinarily repaid at the end of the crop season, and those that ordinarily can be repaid only over several seasons, to which we shall refer in this chapter as intermediate loans.

Few farmers with any insurable property fail to keep it insured against loss by fire or lightning. Farmers' mutual fire insurance is usually cheaper than that furnished by commercial companies because farmers can set up organizations of their own that can carry such insurance more cheaply than the large companies that handle it as if it were urban property. It may not be quite as safe as commercial insurance, but the additional safety is usually not worth the additional cost. This is particularly true if farmers' mutual companies carry reinsurance.

The enactment of financial responsibility laws in part of the states has forced many farmers to carry automobile insurance. Much of this is also carried by farmers' mutuals at rates below those of the commercial companies, though not greatly below those of the large mutual companies operating over wide territory which handle the renewals of contracts from year to year at a very low cost, perhaps as low as 5 per cent of the premium, as compared with 20 per cent or more in many of the stock companies which pay heavy brokerage fees.

Risks of crop failure from hail and tornadoes have been insured in a small way for several decades. In general, the premiums have been so high that most farmers have felt that they cannot afford to carry it. As long as only a few carry it, the costs must be high. Crop insurance for wheat and cotton was provided on a broad basis by Congressional action in 1938. By 1942, nearly a fifth of the wheat crop was insured. In 1943, crop insurance was allowed to lapse, but in 1944, Congress authorized extending crop insurance to wheat and cotton again and added flax to the list, and several others on an experimental basis. J. C. Clendenin concluded, however, after a study of the experience with wheat crop insurance through 1941 that it was not being used widely enough in the high-risk areas to accomplish its purpose.[1]

[1] *Federal Crop Insurance in Operation*, Food Research Institute, Stanford, California, 1942.

Insurance against work hazards is carried only in a small way by farmers. In New York State in 1942, for example, only 24,000 agricultural workers were protected by such insurance. The coverage is best in the territory where the farmers' mutuals are offering such insurance. The rates prescribed in the "manual" are followed by the stock and larger mutual companies, but the farmers' mutuals write at a discount from the manual rates, and may also return a fraction of the premiums advanced as do the large mutuals. The manual rates run, in the different states, from less than $2 per $100 of pay roll to over $5, with $30 as the usual minimum premiums. They usually provide benefits of $15 a week up to a limit of 52 weeks, with $1,000 for the loss of life, sight, or limbs.[2]

When business and family living are as closely associated as in agriculture, personal losses are also financial reverses. Traditionally, the conventional method of providing against personal hazards is through life insurance. Farmers have been slow to take out life insurance. A survey made in 1935–1936 showed that only 43 per cent of white nonrelief farm families were carrying insurance and these were paying annual premiums of only $88. For the net income groups below $1,500, only 38 per cent were carrying insurance. These figures compared with 70 per cent for urban families.

Farmers have been slow to buy life insurance, in part because of their traditional dependence on the building of estates to provide for their families, in part because they have hesitated to commit themselves to making definite insurance payments each year in view of the uncertainty of their income, and in part because life insurance takes a relatively high slice out of the average farmer's cash income. The best time to take out insurance is in early life, and this is the period when young farmers are trying to accumulate the means wherewith to buy working capital and start farming.

FARM VERSUS CORPORATION FINANCING

Before proceeding to the detailed problems of financing agriculture, we need to get clearly in mind some of the special characters of the usual agricultural loan. These derive in part from the nature of the business organization being financed.

1. The whole amount of the investment in a corporate enterprise is in effect borrowed, that is, stock is issued for all of it. The purchaser of a farm must have some money of his own to put into it, ordinarily as much as half.

[2] See John D. Rush, *Analysis of 7,851 Fatal Farm-Work Accidents, 1940–43*, U.S.D.A., B A E, Washington, 1945.

2. Most farm businesses are one-man units as distinguished from partnerships and corporations. This means that they do not have the limited liability of corporations. The stockholder of a corporation risks only what he invests in the stock which he purchases, but the one-man entrepreneur makes himself liable in case he fails for all of his personal wealth, not only what he invests in the farm, but any other property that he may have — except that many of the states have laws exempting a certain amount of agricultural property from attachment to cover debts.
3. A consequence of the foregoing is that the success of the farm and the fortunes of the family are indissolubly tied together. A farmer cannot put part of his resources in another enterprise and keep it from being attached to meet obligations arising from the farm business.
4. In a one-man unit like a farm, the financial responsibility and the responsibility for management are in the same person. In a corporation, the management is hired. The officers of the corporation are likely to be only minority stockholders.
5. Saving and capital formation take place in a farm business automatically, without any formal action on the part of the board of directors.

Partnerships are almost the equivalent of one-man units so far as most of the foregoing considerations are concerned. There is the same unlimited liability and the same close tie-up between financial and operating responsibility. Partnerships, however, are almost as scarce as corporations in agriculture.

MORTGAGE LOANS

Let us now consider the financing problems of a man buying a farm in part on borrowed capital. How much can he safely borrow? What terms should he accept? From what type of agency should he borrow?

HOW MUCH TO BORROW The Congress of the United States expressed a sort of judgment on the question of how far one should go into debt in buying a farm when in the Federal Farm Loan Act of 1916 it set the upper limit at not more than 50 per cent of the value of the land plus 20 per cent of the value of the buildings and improvements.[3] At least Congress said it is not good policy for a loan agency in which the government is involved to go beyond this limit. In the Emergency Farm

[3] This combines to make 43 per cent at present land and building values.

Mortgage Act of 1933, however, Congress raised the limit to 75 per cent on Land Bank Commissioner loans, designed to take care of loans whose security had been reduced as a result of the severe decline in land values. Personal property and even growing crops could be taken as collateral for such loans. The excess over the 50 + 20 limit was ordinarily covered by a second or junior mortgage. Then in the Flannagan Act of 1945, the limit was raised to 65 per cent of the value of the land and buildings combined.

In the meantime, loans to purchasing tenants under the Bankhead-Jones Act have commonly been made for the full value of the farm, the tenants supplying part or all of the working capital. Up to and including 1944, the purchasers of farms under the Bankhead-Jones program had average assets of $1,800 against a total investment of $7,400 in farm and working capital. Up to and including 1941, that is, excluding the years favored by high wartime prices, the Bankhead-Jones borrowers had a record of repayments as follows: 66 per cent ahead of schedule by an average of $912, 16 per cent on schedule, and 18 per cent behind schedule by an average of $232. The early loans were made while agriculture was still depressed. These loans, however, were made on the basis of much more careful advance planning than most mortgage loans. The intention was to put the farms on a productive basis as a condition of the making of the loan.

The experience of the two decades between the wars strongly suggests conservatism in mortgage loans. Chart 100 shows that farms purchased with small down payments at the high values prevailing in 1917–1920 were foreclosed or assigned in large numbers beginning as early as 1922. If the severe depression of the 1930's had not come along, the forced sale rate would have declined to normal by 1935. Instead, it turned upward to a sharp peak in 1932, which led Congress to pass the Emergency Farm Mortgage Act providing for the Land Bank Commissioner Loans; also in 1934 the Frazier-Lemke Act declaring a moratorium on foreclosures.[4] Surely in this period the purchase of farms under heavy mortgages provided highly insecure tenure and caused very great injury to several hundred thousand promising young farmers.

These loans had been made, however, during a period of inflated prices in general and of farm real-estate prices in particular. Even those made by the Land Banks were on the basis of inflated farm appraisals. Except for those made by the Land Banks, they were for short terms and none of them had the variable payment provisions of the tenant-

[4] This was declared unconstitutional by the United States Supreme Court in 1935, but milder state acts were not.

purchase loans. The decline in interest rates on mortgages also makes mortgages easier to carry now. The Committee on Postwar Agricultural Policy of the Land-Grant Colleges concluded in 1944 that mortgages could safely run as high as 85 per cent of the value of the farm if the appraisal was sound and the interest rates and the repayment schedule reasonable.

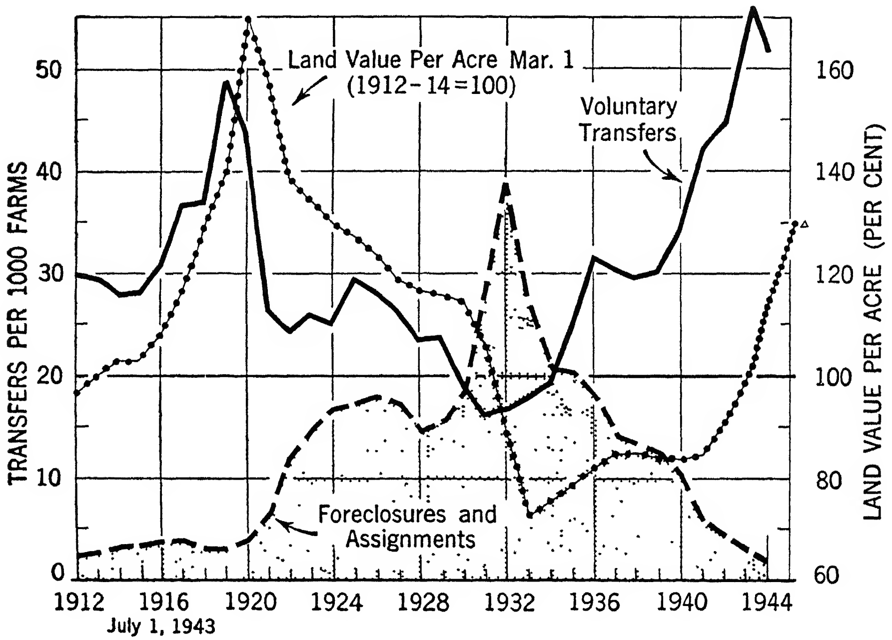

CHART 100. Volume of foreclosures and assignments, voluntary transfers, and index numbers of value per acre of farm real estate, 1912–1944. (*Agricultural Outlook Charts*, 1944, p. 29.)

THE TERMS OF MORTGAGE LOANS The terms of repayment of mortgage loans, it is apparent from the foregoing, are also a very important factor in determining the amount to borrow. Rarely should the period of the loan be shorter than is required to pay off the mortgage after allowing for a reasonable factor of safety. If the interest payments are kept up-to-date, most mortgage-holders are very glad to renew loans; if they are not, usually an insurance company or the Farm Credit Administration will be glad to take the mortgage. However, the history of the last two decades warns us that farmers may hit a series of years when they cannot even pay the interest on their loans. Not only may the low prices of depression years like 1930–1933 repeat themselves, but also series of dry years may come again anywhere west of Iowa. The mortgage-holders

are in a position to foreclose at such times if they wish, and among them may be some who are looking for chances to obtain title to farms under terms favorable to them. The individual farmer should not put himself in a position to be at the mercy of such mortgage-holders. Farmers should not lie awake at night worrying over what may happen to them in case their interest payments are delinquent during a series of bad years.

The insurance companies now generally offer the option of long-term amortization loans, and the F C A's loans have been on a 33-year amortization basis from the beginning. But private individuals often do not like to make long-term loans because of complications this may introduce if their estates need to be settled before the mortgage expires.

More important than the period of the loan is provision for varying the payments on the principal from year to year according to the income of the farm. The insurance companies, with a few exceptions, do not allow variable payments. The Bankhead-Jones loans are now all made on the variable basis. The F C A has gone as far as it can in this direction without amending the language of the Farm Credit Act. Under its flexible provisions, the borrower agrees to pay taxes, insurance, and other fixed charges, plus a share of the crop or income, and any installments or portions thereof remaining unpaid are carried to an extension account to be redeemed by the excess income of better years.

FROM WHOM TO BORROW At the time of the last available report,[5] 37 per cent of the outstanding real-estate mortgage debt in this country was being carried by federal agencies, mainly the F C A. The insurance companies were carrying 17 per cent of it; the commercial banks, 8 per cent; and private individuals, most of the remaining 38 per cent. The life insurance companies reached their peak of $2,200,000,000 in loans in 1927, and were down to $1,000,000 by 1936. Beginning in 1933, with the provision for Land Bank Commissioner loans, presently totaling half a billion dollars, the federal land bank holdings rose very sharply. The experience of commercial banks with frozen assets in 1921 and the years following caused them to reduce their mortgage holdings by over a billion dollars by 1936.

The bases for a decision as to whom to borrow from are pretty well indicated by discussion under earlier heads. The major consideration should be the provision for repayments. First of all, the term of the mortgage should be long enough to give the farmer a chance to pay off

[5] *Agricultural Statistics, 1943,* Table 573.

the mortgage entirely with a reasonable margin of safety, and second, the schedule of payments should be variable according to farm income.

The safety of the borrower is also increased if his mortgage is carried by an agency which writes mortgages over a larger territory and has the security resulting from this. The insurance of bank deposits has made loans from insured local banks safer than they were. Individual lenders sometimes need the income from their mortgages badly in depression periods. The financial position of the lender is important. Can he get along without annual payments on the principal, and even interest payments, in a very acute emergency such as in the early 1930's?

It is interesting in this connection to compare the foreclosure rates of the various lending agencies at various stages of the Big Depression. In 1934, the insurance company rate of foreclosure was five times that of the F C A, and that of individual lenders was almost as rapid. Commercial banks were foreclosing at only about half the rate of insurance companies. By 1938, however, the F C A rate was twice that of the insurance companies, and the commercial bank rate was intermediate between that of the F C A and the insurance companies. By this time, the insurance companies had pretty well closed out their poor mortgages. It thus appears that the insurance companies did not hold off as long as the other agencies when farmers became delinquent in the depression beginning in 1930. Apparently the other agencies give the farmers a longer chance to get back on their feet.[6]

The rate of interest is also of enough importance so that the farmer should not let the time it takes to have his farm appraised, his title examined, and a plan of operation and operating statement for his farm developed, stand in the way of a saving of one per cent or more in the interest rate; nor should the farmer allow a liberal appraisal or a liberal loan seduce him into accepting a loan with hazardous repayment provisions attached to it.

On some mortgages the fees for appraisal, clearance of title, and the like, also may be of considerable importance. In the territory of the New Orleans Federal Land Bank, half of the mortgages are written for $500 or less, and in some of the other regions, as many as a fourth of them. The total fees are limited to one per cent on loans from the F C A. This means only $5 on a $500 loan.

Finally the borrower needs to consider whether the $5 in capital stock that he is contributing to his local farm loan association if he borrows from the F C A, is an investment upon which he will receive returns,

[6] *Farm Mortgage Credit Facilities in the United States*, U.S.D.A. Misc. Pub. 478, 1942, p. 41.

or whether in effect it is merely an addition to the cost of his loans. Which it is depends upon the financial status of the particular loan association.

The present distribution of lending between public and private agencies is abnormal. It is in part the result of twenty years of low farm incomes and declining land values, and in part due to the failure of private agencies to adjust their methods and terms of repayments to the needs and demands of the changed situation and to the changed thinking of farmers on credit matters. It is reasonable to expect that they will revise their methods as needed in the decade or two following the war.

DEBT-CARRYING CAPACITY A major consideration for all mortgage loans is, of course, the debt-carrying capacity of the farm. This differs from net income in that the net income must provide for the farm family before anything is left to pay on interest and principal of the debt. Hence it involves more than simple appraisal of the farm. Farms may be appraised accurately enough but still not yield enough net product to support the family and pay off the mortgage. Or, if the problem is approached from the standpoint of the landlord, the farms may not pay enough rent to carry the debt.

The reasons for the lack of debt-carrying capacity of some farms is that they are too small or the land is too poor. Often these are two ways of saying about the same thing. If poor land does not yield enough net income to carry a debt, no matter how many acres of it are in the farm, this usually means that the land is being farmed in too small units and being farmed too intensively. It may be used to grow wheat when it has only sufficient rainfall for grazing; or to grow cotton when it should be used in larger tracts for corn, peanuts, Bermuda grass pasture, and diversified farming; or to grow corn and wheat when it should be used for hay and pasture.[7]

In times past, credit agencies often made the mistake of assuming that a loan on a farm with small productivity was safe provided the mortgage was kept small. As a matter of fact, in most cases no mortgage is safe on a farm that does not yield enough net income to do more than support the farm family. A few borderline farms may support a $2,000 mortgage and not a $3,000 mortgage, but generally speaking if they will not support the latter they will not support the former.

Table 81 shows the number of years of 1940 net farm income that would be required to pay for an average farm *if none of it were used to*

[7] See John D. Black, "Notes on 'Poor Land,' and 'Submarginal Land,'" *Journal of Farm Economics*, May, 1945.

support the farm family. The range is from 4.4 years in the East South Central states to 8.7 years in the Pacific states. Probably, however, about all of the $520 net farm income in the East South Central states would be needed to support the family so that there would be very little left to pay toward the mortgage. The other two columns of the table show the average mortgage debt per farm in the state, and the number of years that would be required to pay off this debt if the net farm income were all used for this purpose. The Pacific and Mountain states are among the lowest on this basis and the Great Plains states are highest. Chart 101 presents these data graphically for a selected list of states.

TABLE 81. YEARS OF 1940 NET FARM INCOME REQUIRED TO PAY FOR FARMS AND TO PAY OFF MORTGAGES IN 1940, IF ALL THE NET INCOME WERE USED FOR THESE PURPOSES

Divisions	*Value of average farm*	*Average net farm income*	*Years to pay for farm*	*Average mortgage debt*	*Years to pay off mortgage*
New England	$5,480	$ 720	7.5	$2,170	3.0
Middle Atlantic	5,860	905	6.5	2,420	2.7
East North Central	7,290	995	7.4	2,810	2.8
West North Central	8,060	1,045	7.7	4,025	3.8
South Atlantic	3,100	660	4.7	1,575	2.4
East South Central	2,270	520	4.4	1,345	2.6
West South Central	4,390	780	5.6	2,225	3.8
Mountain	7,620	1,150	6.6	2,935	2.6
Pacific	11,720	1,350	8.9	3,440	2.6
United States	5,520	850	6.5	2,650	3.1

Source: The net farm incomes for 1939, 1940, and 1941 were used to give a stable average centered on 1940.

It follows from the foregoing that the net productivities of the farms need to be carefully analyzed. The best procedure for this is for the farmer and the lending agency together to develop a plan for the operation of the farm that promises to yield the largest net income, following the lines laid out in Chapters XXVIII–XXIX on "Farm Planning," and then to estimate as carefully as possible the receipts from sales of crops and livestock that can be reasonably anticipated over the life of the mortgage, and to derive therefrom a net-income statement. Then they should estimate how much of this can be spared for paying the interest and principal on the mortgage. Budgets for anticipated family

expenses, such as described in Chapter XV, will be helpful in two ways; first, in that they will indicate approximately how much will be required by the family; and second, in that having such a budget prepared, the family will be more likely to adjust its expenses to the allowances in the budget.

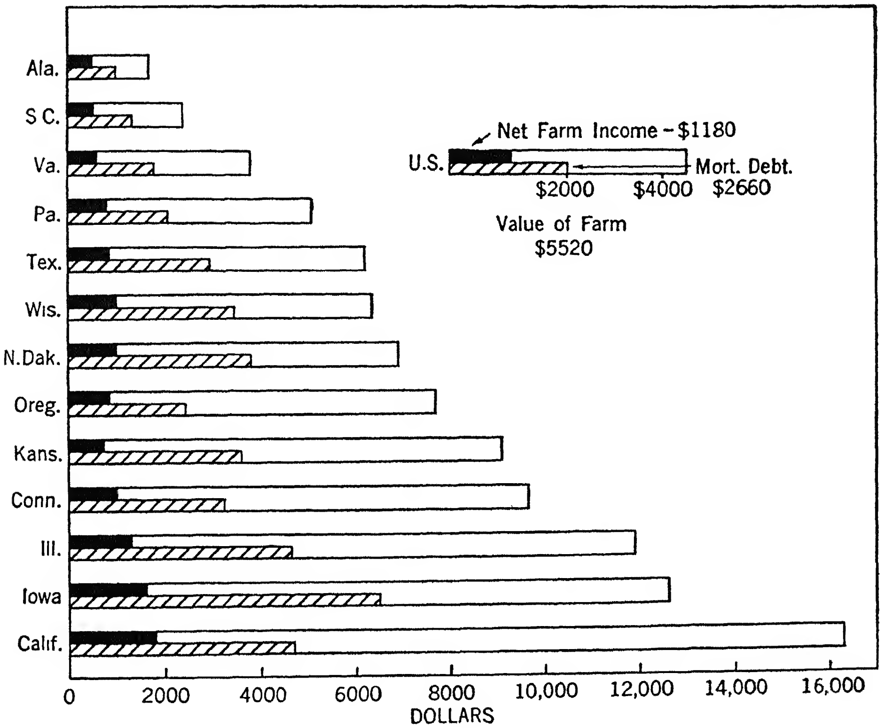

CHART 101. Ratio of net farm income to mortgage debt and value of farm for selected states, 1940.

INTERMEDIATE-TERM LOANS From this point on in our analysis of the financing of agriculture, let us consider ourselves as either already having acquired a farm, probably under a mortgage, or as being a tenant with a good lease. Our needs are for what were defined early in the chapter as intermediate-term loans and short-term loans. As already stated, intermediate- and short-term loans run together because many of the former are made as short-term loans with expectation of renewal not only once but often several times. Technically speaking, intermediate loans are usually considered as those running from one to three years. They may be secured by regular real-estate mortgages or by chattel mortgages, or may be covered by ordinary promissory notes.

Intermediate credit as such receives little attention these days. It may come to the fore again within a few years after this world war as it did after the last one. Inadequate provision for such credit was the center of most of the discussion of agricultural credit from 1921 to 1924. The Minnesota bank examiner gave "frozen assets" as the reason for the failure of 108 out of 177 banks in Minnesota between 1920 and 1926, and related causes like "depleted reserves," "excess loans," and "a run on the bank," as the reason for the failure of 40 more of them.

The loans that became frozen assets were mostly not made during the war, but in 1919 and 1920 after the war was over. Farmers were led to believe during the war that prices would decline sharply when the war ended. Instead, they first leveled out for a few months and then started upward again. The farmers shortly began thinking that high prices were here to stay and borrowed money freely for all sorts of purposes. Buying of farms at high prices was their most serious mistake, but they borrowed to buy machinery and livestock, to improve their farms and their homes, and for all sorts of intermediate-term purposes. The break in commodity prices came in July 1920, and the break in farm real-estate prices followed immediately.

The farmers not only went into debt for themselves, but they voted large expenditures for roads, bridges, schools, and public buildings at the prevailing high prices. As a result, taxes on farm property doubled between 1915 and 1920, and kept on rising until 1929 although at a slower rate. Farm real-estate taxes were twice as high in 1929 as in 1910–1914 even after allowing for the rise in the price level. Part of the reason for the rise in the later twenties was that much land had become tax delinquent, which made it necessary to collect more taxes on the rest of the land. By 1930, a fourth of the farm land in South Carolina and Tennessee was tax delinquent, and still higher proportions of it in some sections of the West and in the northern portions of the Great Lakes states. In these extreme cases, additional causes, like the boll weevil in the South, were contributing factors; but basic everywhere was the decline in farm prices after the public debt had been incurred at the high levels of the war and immediate postwar years.

The principal method of escape from the difficulties of the 1920–1923 period was the refinancing of intermediate-term debt, and even some of the short-term debt, by including it in existing real-estate mortgages, or writing new mortgages to cover it. Between 1920 and 1930, the insurance company holdings of farm mortgages rose from $1.2 billion to $2.2 billion; and the holdings of the Land Banks, from $400 million to $1.2 billion. The rural banks' holdings of farm mortgages fell off propor-

tionately. After recovering on their loans in this and other ways, 50 of the 177 banks in Minnesota were able to reopen.

Many of the mortgages enlarged during the 1920's could not be carried through the depression of the 1930's when prices of farm products fell 37 per cent below the 1910–1914 level and land values 28 per cent below this level. The rate of forced selling rose to 40 per thousand farms in 1932. The banks were failing at a rate greater than in the early twenties when the bank holiday was declared in March, 1933. Refinancing debts again became an important function of the Federal Land Banks from 1931 on.

The Farm Credit Act of 1933 made special provisions for what it called "production credit." It permits loans up to three years. This surely might have been interpreted to include intermediate credit as well as annual advances. Except in two or three of the districts, however, the F C A handles intermediate-term loans as if they were short-term loans, the farmer committing himself to repay in one year what he cannot be expected to repay in less than two or three. The official statement of the F C A on this subject is as follows: "Renewals of a portion of some types of loans, such as those for the purchase of heavy machinery and other items of a semi-capital nature, are frequently anticipated at the time the loans are made. If at maturity the credit factors remain satisfactory, no difficulty is experienced by either the member or the association in arranging for the renewal." [8]

The commercial banks have made more headway in this direction, in recent years, than the F C A. Several hundred of them are now making intermediate-term loans under repayment schedules running over two or three years.

The public credit agency which has really developed intermediate-term credit for farmers is the Farm Security Administration. Most of its standard "rehabilitation" loans provide intermediate credit to buy livestock and other working capital, to be repaid within a period of five years according to a schedule of annual payments that is carefully defined. These loans, however, are supposed to be made only to "low income" farmers and most of them are for less than $1,000. The F S A is not supposed to make loans to farmers who have larger resources and who can borrow at commercial banks. The F S A also distinguishes clearly in making its standard loans between the sums advanced as annual operating loans and those not recoverable within one year. A schedule of repayments is worked out for the second running over as many years as deemed necessary up to the five-year maximum. These

[8] "The Production Credit System," Farm Credit Administration, August, 1945.

loans are revised each year, the annual loans being renewed as needed, and the schedule for the others readjusted. The loans for livestock and the like may be increased at such times if the earning power of the farm can be enlarged in this way. Around a half million of such loans were outstanding the last year before the war.

The Rural Electrification Administration loans now run for 35 years, under an act of Congress in 1944, with no payments the first 5 years, and monthly installments of interest and principal over the next 30 years. They are thus intended to be fully self-liquidating. They are made to cooperatives and not to individual farmers.

The principles that should guide intermediate borrowing should now be clear. They are much the same as for long-term loans.

1. The borrower should not be scheduled to repay a loan in a shorter period than the loan will pay out, with a reasonable margin of safety. In view of the dangers of loss of markets and business recessions, the borrower should not gamble on the expectation that the creditor will gladly renew the loan.
2. The converse of the foregoing, namely, the term of the loan should not be longer than the life of the asset. If a corn picker is likely to wear out in three years under the custom use which is planned for it, the loan should not run for longer than three years.
3. The schedule of repayments should be adjusted to the rate of return on the investment.
4. Loans from an agency that is in danger of getting itself into a distressed position should be avoided.
5. The terms of the loan should provide for drawing the funds only as rapidly as they are needed, and for paying interest only for the period while the funds are used. The Production Credit Associations work this out very carefully. It is a reasonable requirement and the borrower should insist upon it no matter which agency he is dealing with.

Obviously if the foregoing rules are to be followed, the loans need to be based on farm operating plans and budgets of expected receipts and expenses. Commercial banks should insist upon such plans the same as government agencies.

LOANS FOR THE ENLARGEMENT OR IMPROVEMENT OF FARMS

The most serious gap in the present provision for agricultural credit in this country is loans to enable farmers on small or poor farms to get enough agricultural resources under their control to turn their farms

into economic units. This may call either for acquiring additional land, or improving some of the land which they now have by clearing, drainage, irrigation, terracing, or pasture or woodland improvement.

Farmers already owning economic units, unless under excessive mortgages, can borrow money for these purposes from the banks or the F C A. The ones who really need such credit are those who already have mortgages on small farms and are having difficulty carrying even the mortgages which they have because their farms yield such small returns; or their farms are not mortgaged, but their earning power is so low that lending agencies do not consider them safe risks. Farmers in either of these situations are in a vicious circle. They are not able to borrow because they have so little resources; and only with great difficulty can they increase their resources without borrowing in order to get command of more resources. A large fraction of the farmers in these difficult circumstances are, of course, too far along in years to safely reach out and buy more land. Others are poor farmers, or at least can be made into successful farmers only with great pains. Still others are unthrifty and improvident farmers. But in the midst of all these, in an ordinary state, are many thousands of relatively young men who need only to be given a chance in order to increase their earning power; and the next five years will bring along as many more thousands. In twenty-five years, the earning power of several hundred thousand young farmers can be greatly increased in this way.

The present sources of such loans are an occasional commercial bank which senses its opportunities in this line, and the Farm Ownership branch of the F S A, which now interprets its charter to include such loans. Its funds are too limited, however, to reach many of these farmers.

It may be helpful to consider the geographic distribution of the need for such loans. In large sections of the United States, the land is rough and only a small part of it can be cropped. The whole Appalachian and adjacent piedmont region answers this description. The farms in this territory need to have more land so that they can keep more livestock and have larger incomes. The people living in this territory should not be forced to eke out a meager living trying to grow a few acres of corn and other food crops on steeply sloping fields. Many of these farms should also include sizable woodlands which would furnish employment at slack seasons of the year and furnish an additional source of income. This country is going to need timber badly in the next hundred years, and this is one of the best ways in which it can be provided.[10]

[10] See Ch. XLVI.

The South, of course, has more undersized farms than any other region. On its more level lands, the farms need to be enlarged so that they can grow their cotton with more machine labor and less hand labor and thus grow more of it. In the piedmont and hill sections of the South, the farms need to be enlarged so as to take in land that can be used for pasture and to grow feed for livestock, and in many cases to combine timber growing with diversified farming. Much of the South is natural pine region where trees grow very rapidly and woodlands can provide important additional income.

The dairy-farming regions of the Northeast and the Lake states also have many sections in which the farms should have more land so that more cows can be kept. Timber growing can be combined with dairying to excellent advantage in many parts of this region.

Even in the Midwest, the tendency is for farms to be smaller on the poorer lands than on the better lands. This is well illustrated by the comparison of Douglas and Jasper Counties in Illinois that was introduced in Chapter XXIV. The differences between these two counties cannot be entirely made up by putting more land in the Jasper County farms, but it can be made up in large part in this way and by converting the agriculture more largely to a hay-and-pasture basis. If a program of lending money to deserving young farmers in Jasper County to enable them to buy more land were developed, and no more than 2 or 3 per cent of these young men were helped each year, within twenty-five years about all the farms in Jasper County that need it will have been enlarged.

SHORT-TERM CREDIT

Chart 102 shows that, taking the country as a whole, more short-term credit is furnished by commercial banks than by all other types of agencies combined. Such loans are usually discounted with the Federal Reserve Banks. Such loans can run for as much as nine months, but most of them are for ninety days to six months. In many sections of the country, however, more credit is furnished by merchants than by banks. Merchant credit includes credit for feed, fertilizer, seeds, and the like, much more than it does ordinary store credit. The "Other F C A Agencies" in the chart include mainly the Emergency Crop and Feed Loans.

We shall obtain a clearer understanding of problems in short-term credit if from this point on we consider a number of special situations. In practice, of course, as indicated earlier, many of the short-term loans,

though secured by personal notes or collateral other than real estate, are actually used for real-estate purposes. A study made in Minnesota in 1926 showed that half of such loans made by landowners were for building improvements or for buying additional land. The tenants borrowed almost solely to buy farm machinery and livestock, which are really intermediate-credit purposes. In the South, however, the short-term loans are mainly for operating expenses. In the West and in parts of the Corn Belt, many of them are to buy cattle and hogs for the grazing or fattening season.

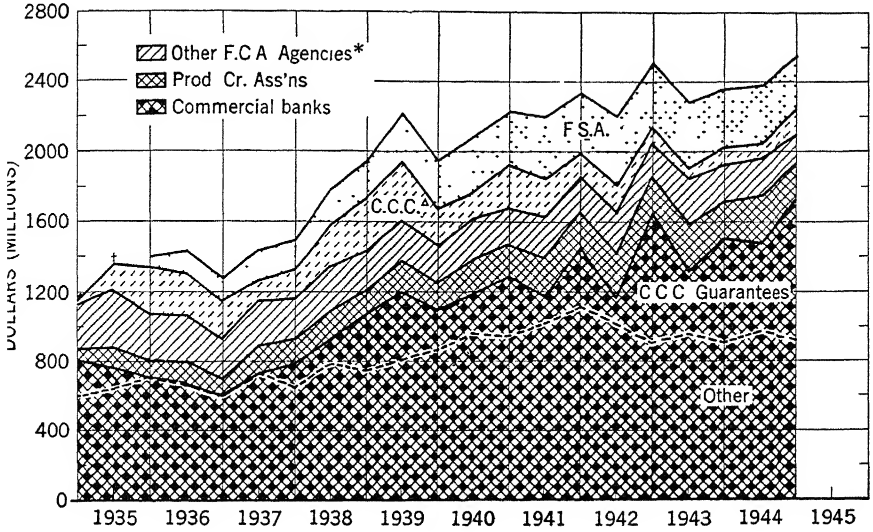

CHART 102. Distribution of cash short-term loans among lending agencies 1935–1944.

THE EASTERN SHORE OF MARYLAND This is an area of heavy annual borrowing for fertilizer, feed, seed, and other supplies used in the production of truck crops, fruit, Irish potatoes, and broilers. The principal truck crops are tomatoes, cantaloupes, and cucumbers. Strawberries are the principal fruit. A study made in 1940 showed that 70 per cent of the loans were merchant credit, 20 per cent cash credit, and the remainder installment and open account.[11] The local banks furnished half of the cash credit, private individuals a seventh, the F S A and the Emergency Crop and Feed Loans Offices an eighth each, and the Production Credit Associations only a sixth. The P C A's have never been able to get much of a foothold in this territory. They have found

[11] P. R. Poffenberger, S. H. DeVault, and W. J. Lodmen, *Short-term Credit on the Lower Eastern Shore of Maryland*, Maryland Bull. A8, 1942.

competing with the fertilizer and feed merchants an uphill struggle. The interest rates for cash credit are low in this area, only 6 per cent from the local banks as compared with 5 per cent from the F S A, $4\frac{1}{2}$ per cent from the P C A's, and 4 per cent for the Emergency Crop and Feed loans.

The average cost of the merchant credit, in contrast, is 18.6 per cent. Feed purchases accounted for 60 per cent of this merchant credit, most of this being feed used in broiler production. The broiler business is conducted about 90 per cent on a credit basis, credit being used to purchase feed, chicks, and fuel. The feed loans mostly run for 60 to 120 days, at an average interest cost of 16.8 per cent. Fertilizer purchases accounted for 23 per cent of the merchant credit, the notes running for four to six months at an average interest cost of 20 per cent. The principal reason for these high interest costs on fertilizer is that the merchants buy wholesale for cash and receive a discount of 10 per cent from the price which they charge the farmers who buy on credit. The hatcherymen who furnish chicks on credit get 20 per cent interest on their advances. On tomatoes and other plants furnished on a credit basis, the interest cost sometimes runs as high as 25 per cent.

Why do the farmers pay these high interest costs? Partly as a matter of long habit, partly because the real cost of such credit is concealed from them by the discount system, and partly because the federal agencies making loans insist upon crop liens, chattel mortgages, and other good security, whereas the fertilizer and feed merchants operate on a basis of continuing to give credit without security to those who repay their loans promptly each year, and of casting off those who fail to do so, letting federal agencies take care of them. The high interest collections cover their losses from bad risks. The farmers who keep in good standing with the merchants generally have little mercy for those who fail to do so and are inclined to criticize the federal agencies for coming to their rescue. However, the record of losses of the F S A and the P C A's is about the same as that of the merchants. The final factor in the situation is that many of the growers object to preparing an operating statement as a basis for their applications to a federal agency. Commonly they do not have the information about their operation which is needed to prepare such statements. The competing merchants and hatcherymen, it is obvious, are also making abundant credit serve as a way of increasing their volume of business.

FLORIDA CITRUS AND VEGETABLE AREAS Growers of citrus and vegetable crops in Florida in 1937–1938 were getting 72 per cent of their

credit in the form of cash and 28 per cent as merchant credit.[12] Most of the merchant credit was for fertilizer. The cash credit was obtained most largely from P C A's (25 per cent), from cooperative associations (20 per cent), and from banks (12 per cent). The average rate of interest from the banks was 6.9 per cent; from the P C A's, 5 per cent; from one of the cooperative marketing associations, 5.3 per cent, and from the other, 6.5. A particular feature of loans in this territory is that they are frequently used to bind the grower to deliver his product to a specific agency. Discounts for cash on fertilizer are ordinarily 5 or 10 per cent. There is the same disposition to overstimulate production through loose credit practices in this area as in the Eastern Shore area. The usual losses of merchants on advances to growers range from around 5 per cent on fertilizer to 7 per cent on farm machinery. The merchants would prefer to do business for cash. They offer credit as a form of competition.

CREDIT EXTENDED BY MISSOURI COOPERATIVE EXCHANGES The system of cooperative exchanges developed in Missouri has followed the practice of delivering supplies to its members on credit. A study of 87 of these exchanges showed that they had average sales of $133,000 per year, and a third of their assets were accounts receivable.[13] Practically all of this credit is unsecured and without interest, except on old accounts in some cases. The estimated cost of supplying this credit was 3 per cent per dollar of sales, one half of which was losses from bad accounts. The conclusion of the study is that the exchanges should divorce themselves from this credit service, and if that is not possible, adopt some means of charging credit patrons for the cost of the service.

MICHIGAN A study of rural Michigan banks with short-term loans to farmers in 1928 to 1937 showed that three fourths of them were for sums of less than $200.[14] Only 4 per cent of them exceeded $1,000. The P C A loans in Michigan apparently are somewhat larger; the median size in 1939 was $387. Three fourths of all notes to the banks were drawn for a term of less than 6 months, but only two thirds of them were repaid within the 6-month period. Only a seventh of the loans ran for more than 12 months. However, 40 per cent of the original notes were renewed at least once, and 15 per cent of the borrowers were continuously indebted to their banks over the ten-year period of the study. Around 90 per cent of the borrowings were for production purposes and 10 per

[12] J. Wayne Reitz, *Production Credit in Florida Citrus and Vegetable Areas*. Florida Bull. 367, 1942.

[13] Ralph E. Mercer and Herman M. Haag, *Amounts and Costs of Credit Extended by Cooperative Exchanges*, Missouri Bull. 415, 1940.

[14] Michigan Bull. 311.

cent for consumption uses. The most common object was the purchase of livestock.

THE CORN BELT The loans to farmers in the Corn Belt states of Indiana, Illinois, and Iowa average considerably larger than the Michigan loans. Throughout the Midwest the larger loans to farmers are commonly made for the purchase of feeder cattle for fattening, and run for the period of time the cattle are on feed — 60 days to a year. A common type of loan in the Corn Belt is the so-called "barnyard loan" in which a mortgage is placed on all the farmer's personal property and the loan may be renewed several times at 6-month intervals. Usually these loans are obtained to increase the livestock herd, purchase machinery, or improve the farm buildings.

In the North Central states as a whole, the commercial banks furnish about two thirds of all the credit not secured by real-estate mortgages, and about four times as much as the P C A's.

SHORT-TERM CREDIT IN THE COTTON TERRITORY One recent report covers a county in southwestern Arkansas where cotton is the principal cash crop, but some farmers grow fruit and vegetables for the market. Nothing is reported concerning merchant credit. The average computed interest rate, after including the effects of charging interest on a flat basis for the full period of the loan, and various fees, was around 16 per cent from the local banks and from landlords, and around 10 per cent from the P C A's. Most of the loans were under $300, as contrasted with several times this amount in the other areas considered. Practically all of the loans were secured by chattel mortgages or crop liens, and a fourth of them were delinquent in December of the year of the study.[15]

AROOSTOOK COUNTY, MAINE The erratic behavior of potato prices makes financing this crop an unusually hazardous undertaking. In the two years 1937–1938, prices received by the growers averaged 43 cents per bushel. In the four years from 1931 to 1934, the prices were 19, 22, 66, and 16 respectively. Relatively few of the growers have capital to finance the whole operation of growing and marketing their crop. As late as 1941, more than 3,000 potato growers in Aroostook County had loans from local banks averaging $700; another 300 had loans from P C A's averaging $1,500; another 1,000 had loans from the F S A averaging $900; and 600 had Emergency Crop and Feed loans averaging $300.[16] These figures total up to around 5,000 farmers obtaining loans in the usual year. In addition, the implement companies make

[15] Estal E. Sparlin, *Farm Credit in Hempstead County*, Arkansas Bull. 399, 1940.
[16] Maine Bull. 418.

loans, and the merchants and some private individuals. The figures are averages for all of Aroostook County. Those in the St. John area do more borrowing in proportion to their assets than those in the Presque Isle area. In 1938–1939, one third of the St. John Valley farmers had F S A loans and half of them had the emergency loans.

Under a system of credit management which is more or less collective, as under the P C A's, it is possible for a whole area to err in judgment. This happened when a P C A was set up in Aroostook County in 1934 which made 2,000 loans the first year and almost as many the year following. Repayments were small and the association was liquidated in 1937. Five new associations were then created, which altogether have been making about 300 loans a year in recent years.

A FINANCIAL PROGRAM FOR THE FARM

If the financing of the farm business is to be well managed, it needs to be planned in advance. Every farm should have a five- or ten-year financial program which lists in order the investments contemplated, with estimates as to the amounts involved. This program can be balanced each year against receipts and carried out in the most advantageous order. Such a list might include the following: reducing the mortgage to safe proportions; improving the dairy herd by replacing four of the poorer cows; buying a new truck to take the place of the present one which has only three or four more years to go; installing a modern wood-burning furnace in the house, or a plumbing or water system; improving part of the pasture by fertilizing it and cutting the scattered brush; draining seven acres of lowland so that it can be brought into the regular rotation systems; planting some hardwoods so as to make the twenty acres of woodland fully productive.

In these financing plans, loans should be used freely, provided they are obtained upon the right terms. Short-term credit should especially be used freely. A farmer cannot afford to hold in reserve the sums of money necessary to finance a feeding operation or the growing of an annual crop, for if he does his capital will lie idle a good share of the time. It is better for him to put any surplus funds which he has into more working capital on his own farm, or even in some outside investments. Working capital is obviously a more remunerative use for funds on a farm than is land and buildings; but ownership of land may have important other advantages, and may be almost essential for long-term undertakings because suitable leases are commonly not obtainable in this country. The most prosperous and best developed agricultures of

the world use credit freely. Danish agriculture, for example, is much more on a credit basis than is ours. But the agricultural credit machinery of this country is still so inept that it must be used circumspectly.

The normal disposition of farmers is to pay off their mortgages in full as quickly as possible. To have a mortgage on his farm is still looked upon as a black mark against a farmer, especially against one who has operated his farm for twenty years or more. Altogether too many farmers therefore postpone enlargements or improvements of their farms and buildings that would increase their earning power and enable them to pay off their debts sooner. The reasonable program for a farmer is to reduce this mortgage debt perhaps to 40 per cent of the market value of the farm; then make any enlargements or improvements that will increase the farm income; then consider needed home improvements; and only as a fourth step to pay off the rest of the mortgage. In this fourth stage, the farmer can afford to consider favorably some types of investment that he would not consider in the first stage, such as herd improvement through culling more closely and buying replacements or buying a sire with a high-producing record, replacing old buildings, woodland improvement, and helping to finance a local cooperative or a local quick-freezing plant.

Some periods, it should now be obvious, are much more hazardous in which to borrow than others. A single year may be enough to ruin the prospects of farmers who have ventured too much. Thus the 1920 crop was sold in the fall at a level of prices far below the expenses which were incurred in the spring. Those who borrowed to produce in that year were not able to repay their loans in the fall. The same thing happened all over again in 1930. The flour millers and the cotton spinners are able to protect themselves in large part by hedging their raw materials in the futures market. Farmers are seldom in a position to do this.

Unfortunately these catastrophes are not commonly foreseen with sufficient clarity to furnish a safe guide to action. The meat-packing companies, with all their high-salaried staffs of business executives, accountants, and statisticians, failed to prepare themselves for the reverses of 1920–1921, and they lost heavily again in 1930. A few general rules can, however, serve the farmer in good stead. One of these is that periods of unusually high prices and high prosperity are not likely to last indefinitely. At such times, farmers should pay off their debts as rapidly as possible and avoid incurring any new debts. They should, at such times, operate on a hand-to-mouth basis as nearly as possible.

Similarly, depression and low prices do not continue indefinitely.

They may last, however, for two or three years or even longer, and farmers should proceed carefully until genuine recovery seems to be under way. As its onset, a depression can ordinarily be expected to continue and overreach itself, and this is also a time not to borrow freely. When a recovery is well under way, it ordinarily can be expected to overreach itself also.

These rules of action do not furnish guidance, however, that can be leaned upon very heavily. One can never know for certain that recovery is really under way. Many businessmen thought that recovery was under way in 1931 when prices leveled out for several months. They thought it was really under way in earnest in the summer of 1933 and again in 1937.

No really safe basis for forecasting general economic and business conditions has thus far been developed. The most thoroughgoing students of business cycles may go wrong in interpreting particular situations. None of them has an explanation for business cycle movements which always stands up in application. However, analysis of general business conditions can be of considerable guidance. The general reports on the business situation issued by the United States Department of Agriculture are about as useful as any such analyses can now be made.

Neither are there any safe general rules to follow with respect to long-time trends or movements of prices over two or three decades. This subject is even more in a stage of speculation than the shorter movements. It is not even safe to assume that prices will decline for two or three decades after this war. It is true that this happened after the Napoleonic Wars and again after the Civil War. The decline after the First World War was halted in 1923–1929, and probably would not have resumed again after 1930 except for the failure of the governments of the world to direct their political, economic, and financial affairs in such a way as to maintain reasonably high levels of production.

INVESTING IN AGRICULTURE

Our discussion of the financing of agriculture would not be complete if it did not consider the question of whether to invest in agriculture at all. Both landlords and mortgage-holders have the alternative of investing their funds in industrial enterprises, public utilities, marketing, and a wide range of other enterprises, and also in government bonds. Farmers can operate as tenants, as they mostly do in England, and put their surplus earnings in nonagricultural enterprises. Finally, as indicated above, owner-operators have the choice between using their sur-

plus earnings to pay off their mortgages as rapidly as possible, or merely reducing their mortgages to a safe level and investing the rest outside of agriculture. They are strongly urged these days, for example, to invest more of their savings in life insurance because this is likely to provide much more amply for their survivors.

The returns to landlords on their investments in land are shown for the United States as a whole in Chart 103 for the years 1912–1944.[17]

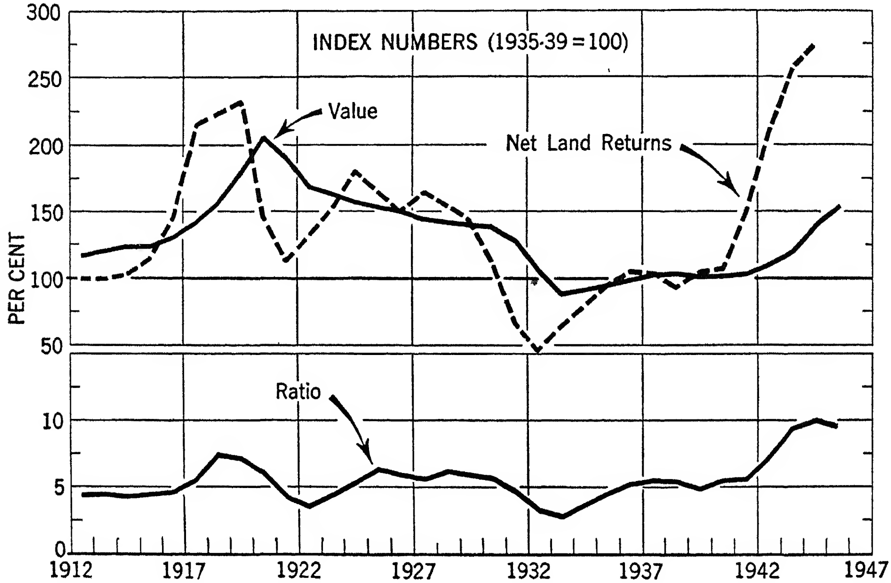

CHART 103. Values and net land returns per acre, and ratios of these two, 1912–1944. (This chart is reproduced from Page 31 of the 1944 *Agricultural Outlook Charts*.)

They have ranged from below 4 per cent in 1922 and 1932–1934, to as high as 10 per cent in 1944, and more than 7 per cent in other years in both the wars. In normal periods, they have ranged around 5 per cent. They were below that level in 1912–1916 when landlords were expecting to gain greatly from rising land values — these had already more than doubled since 1900. They were somewhat above this in 1925–1929 after farm real-estate values had retreated from their 1918–1919 boom, and even slightly above 5 per cent in 1937–1941 because of further declines in farm real-estate values in the early 1930's. Landlords were not expecting to gain from rising land values after 1930.

The net returns in Chart 103 include share rentals as well as cash

[17] Government payments received by landlords included after 1933. Losses from failure of tenants to pay rents not included.

rentals. Share rentals, of course, include the additional return for whatever management is furnished by the landlords, and can be expected to run higher than cash rents. The gross cash rentals in 1940 averaged 5.6 per cent. From this, 1.2 per cent needs to be deducted for taxes, and another 1.0 for depreciation of buildings and fences. This leaves a net return of 3.4 per cent. The share rentals must have been much higher to produce the average of 5.0 shown in Chart 103 for 1940.

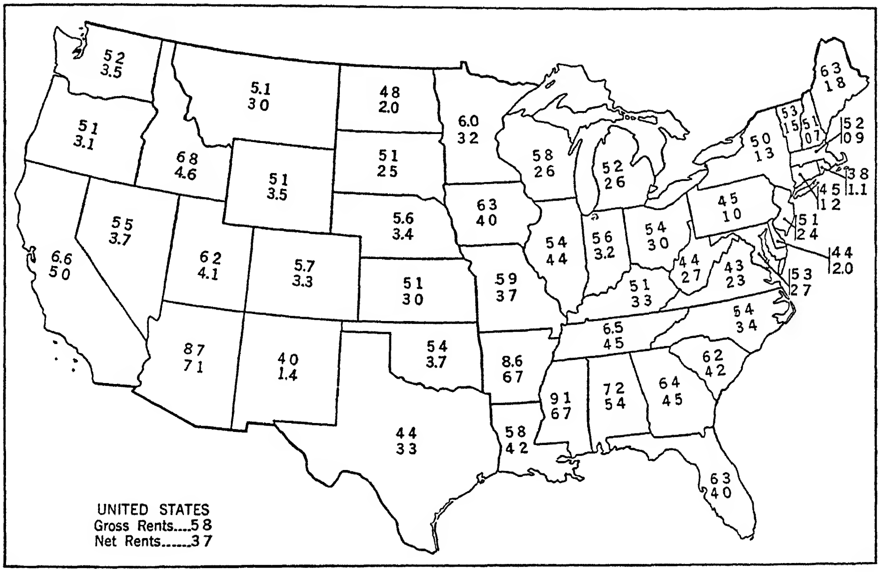

CHART 104. Ratios of gross and net cash rents to farm real-estate values, by states, 1940. (Excluding counties with large cities. The data for this chart were supplied by Mark M. Regan and associates in the Bureau of Agricultural Economics. The cash-rental data came from a joint survey of the Census and the B A E. Taxes, insurance, and a 3-per cent allowance for building repairs were deducted in computing net rents.)

Any one landlord is of course much more concerned about returns on investments in his particular territory. It is not possible to present such data here for units smaller than states. Chart 104 presents the ratios of gross and net cash rents, on all cash-rented land, to farm real-estate values, in 1940 with the counties excluded which have sizable cities in them. The values of farms in such counties reflect residential use more than do the cash rentals. Even with this adjustment, the net cash rentals are down close to 1 per cent in the Northeastern states. Probably the buildings are still over-valued relative to the land in the census figures. The gross rentals mostly run from 5 to 6 per cent in the Midwest, and

the net rentals mostly from 3 to 4 per cent. Cash rentals in the South apparently must compete with the high returns from share and cropper tenancy. Net farm incomes tend to be capitalized at relatively high rates in the South.

One could also figure out ratios of net returns to investment in owner-operated farms, but these would include wages of labor and management. They would run far below net cash rents in 1931–1934, and well above them in the war years. The ratios in Chart 104 pretty well indicate the returns of the owner-operators on their investment in their farm real estate as such — the rest is return to labor and management.

Something more needs to be said, however, about gains and losses from changing farm real-estate prices. Part of these are of the same general order as the gains and losses arising from cycles of business prosperity and depression, and are experienced by owners of other forms of real estate, and of stock in industrial enterprises, public utilities, and the like. The cycles of rise and fall in farm real-estate values follow, however, a different pattern from those of other properties. For example, farm real-estate prices were declining in 1925–1929 when stock prices were rising. The rising relative demand for food in general made land values rise sharply in 1900–1915; after 1920, the food supply of the western world began to press on the population. Tobacco land rose in price when women began to smoke; semiarid wheatland, when the tractors and combines made wheat growing profitable upon it. The boll weevil depressed the values of much cotton land, and the drouths of the 1930's, of much wheatland.

EXERCISES

1. List all of the sources of the different kinds of credit in your area, and ascertain the terms of their loans.
2. Ask your local banker approximately how many farmer depositors he has and what proportion of them have loans from the bank. What are the main purposes for which the loans were made?
3. List the financial failures among farmers in your community in the last five years and analyze the importance of the improper use of credit as a factor in these failures.
4. Do most farmers in your community use too much or too little credit? Why?
5. Select some farm family in your area with whose credit status you are roughly familiar and outline for it a rational financial program.
6. Some observers have noted that farm-raised boys are usually taught how to do all kinds of farm work, but are often kept in complete ignorance of the farm mortgage and other credit problems. If you were a Smith-Hughes teacher or County Agent, how would you help farm boys of your area to think soundly about farm credit problems?

CHAPTER XXXIII

The Valuation of Farm Property

THAT VALUATION OF FARMS IS IMPORTANT WHEN THEY ARE BEING mortgaged, from the standpoint either of the borrower or of the lender, should be obvious after reading Chapter XXXII. Chapter XXXIV will make equally clear that the time when farms are bought and sold is important. Farm property is valued in making opening and closing inventories and estimating changes in net worth. The value given to a particular asset may materially influence the calculated net income for the year. If livestock, for example, is valued at an unreasonably high figure in the closing inventory, a high apparent profit will be made. Then when the livestock is sold, an apparent loss is sustained. The farmer will have been misled by his own accounts, at first into thinking he had made a large profit, and later into an unanticipated loss.

Farms also frequently need to be appraised in the settling of estates. It should never be necessary at such times to sell a farm in order to determine its value. This is especially important when one of the heirs is already occupying the farm and wishes to remain upon it. Appraisal of estates has become more important as farm families have become smaller and more farms pass from one generation to the next without being sold. In Europe where farms commonly remain in the same family indefinitely, the need for such appraisals is so frequent that appraisers have made a profession out of it. The foremost agricultural economist of Germany in the last generation, Friedrich Aereboe, wrote a large book on the subject of the valuation of agricultural properties.[1]

Related to the foregoing is the valuation of unexhausted improvements whenever a tenant leaves a farm, which, as explained in Chapter XXX, needs to be provided for in all leases if tenants are going to do the things necessary to keep up the productivity of farms. As already pointed out, professional "valuers" are employed for this in England. In the West, a related problem takes the form of placing values on the use of public and other lands.

[1] *Die Beurteilung von Landgutern und Grundstücken,* Paul Parey, Berlin.

That problems of valuation also arise whenever any form of farm cost accounting is undertaken was evident in Chapter XXI. Not only must values be placed on the annual use of land in crops, pasture, and woodland, but in different crops; also on the annual use of farm buildings, and on the man labor, horse labor, and tractor work on different crops.

THE PURPOSE OF THE VALUATION

The first major point to get clearly in mind is that the value placed upon a farm or other agricultural property may depend in large measure upon the purpose of the valuation or the use which it is to serve. One frequently hears reference to values of farms as if there can be but one such value and that this can be scientifically determined. If there is any one such value, it must be *market value*, that is, the *price* at which the farm would sell in a perfect market or in some other kind of market. This meaning of the term value applied to farms parallels that of the term market price applied to commodities. We would all be on safer ground if we always used the term price when we had this meaning in mind, but common usage has accepted the term value for the price of land and of farm real estate, just as it has accepted the term wages for the price of labor, and the term interest for the price of capital. The price for the use of land and other property for a limited period such as a year, has similarly acquired the special term rent. In this chapter, we shall use the term *market value* when we have in mind merely the price of a farm.

Different from market value in many situations are *loan* value, *assessed* value, and *insured* value. They may differ because the laws of the country determine the basis on which loan values or assessed values are determined; or regulations of credit agencies, or of tax or insurance authorities; or the established practice or custom. *Normal loan value* is determined by the Farm Credit Administration partly as a matter of legislation and partly by regulation.

THE VALUATION OF FARMS

Valuation is particularly important for durable assets. At the top of the list in durability is land; some land improvements are as durable as the land itself, and buildings and orchards are highly durable. A durable asset derives its value from the "stream" of income that flows from it over the years.

CONSTANT INCOME A farm derives its value from an income stream expected from it in perpetuity. The valuation problem is simplest when this stream is expected to be constant in amount from year to year and to continue indefinitely — as when a landlord, for instance, expects to obtain \$500 annually from the rent of a farm as long as he lives, and his heirs and assigns after him. Under this assumption, the value of the farm is the sum of money that would yield \$500 per year at whatever rate of interest is assumed over the years. At 4 per cent interest, it would take \$12,500 to yield an income of \$500 per year. The formula for this is very simple:

$$\text{(I)} \qquad \text{Present Value } (PV) = \frac{\text{Expected Annual Income } (a)}{\text{Expected Rate of Interest } (r)}$$

If the expected rate of interest were 5 instead of 4 per cent, *PV* would equal \$10,000; also if the expected annual income were \$400 in place of \$500.

The reader will note particularly that both *a* and *r* are *expected* and not *actual*. They cannot be anything but expected, for no one knows what the incomes will be until they are actually received, and future interest rates may be different from present interest rates. Land in this respect differs from a high-grade bond which offers a definite and highly certain income each year. It also differs from a bond in that the bond runs for only a term of years.

INCREASING OR DECREASING INCOME These simple relationships do not hold, of course, if the income stream is expected to be greater or smaller over a period of time. If it is expected to increase or decrease regularly and indefinitely, the formula for it is expanded from I to include another term as follows:

$$\text{(II)} \qquad PV = \frac{a}{r} + \frac{i}{r^2}$$

where i equals the *expected annual increase* in the annual income. Thus if it was expected that the annual income of the farm in the above illustration would increase steadily at the rate of \$4 per year, *PV* would equal \$15,000 instead of \$12,500; that is

$$PV = \frac{\$500}{\$.04} + \frac{\$4.00}{.0016} = \$12{,}500 + \$2{,}500 = \$15{,}000.$$

An expected steady decrease in the annual income would have the opposite general effect.

Just this sort of thing happened to farm values in this country in the fifteen years before the First World War. Prices of farm products were

rising faster than the wages of hired labor and the prices of supplies and equipment bought by farmers. As a result, net farm incomes rose and farmers began to expect them to keep on rising. The general price level was rising at the same time. Farms doubled in value in ten years after 1900. In Iowa, they rose from $43 per acre to $96. The cash-rented farms of Iowa were worth $99 per acre in 1910. The Bureau of Agricultural Economics has estimated from Formula II that the value of this land would have been $78 in place of $99 in 1910 except for the expected increase in annual income, and that the farmers were in effect expecting net income to rise 6.4 cents per acre per year.[2] The values inserted in the formula were $PV = \$99$, $a = \$4.30$, and $r = .055$, the .064 being the unknown to be determined.

$$\$99 = \frac{\$4.30}{\$.055} + \frac{.064}{.003025} = \$78 + \$21.$$

At the peak of the land boom in 1920, cash-rented Iowa land was valued at $253 per acre and renting net at $7.62 per acre, and its then present value was divided between the two parts of the formula as $139 and $114. Thus, approaching half of the 1920 value was based upon an expected increase in annual earnings. By 1940, the same cash-rented Iowa land had declined in value to $86, and the net annual income to $4.20. The $86, according to the formula, was divided as $77 and $9. Even at the low level of net farm incomes, the farmers were expecting net incomes to increase 3 cents per acre per year.

In these thirty years, the $\frac{a}{r}$ part of the formula changed from $78 to $139 to $77; the $\frac{i}{r^2}$ part of it, from $21 to $114 and back to $9. Thus the second part of the formula is much more variable. It is often referred to as the "speculative" part of land values. However, both parts are speculative. All future incomes are speculative, since we cannot know them in advance. One can no more assume that a is a constant than that i is a constant. The fluctuations in i, however, are likely to exaggerate the fluctuations in a.

"TRUE" VALUE Some persons are always talking about the *real* value of land, or its *true* value, meaning some value based on its "true earning power." All that they can possibly mean by this is some value based on the assumption that a particular net income is the true net

[2] M. M. Regan, F. A. Clarenbach, and A. R. Johnson, *The Farm Real Estate Situation*, U.S.D.A., Circular 721, 1943–1944, p. 20. See latest annual issue.

income. They may have in mind the net income at the time, or instead the net incomes of some past period conceived as *normal*. Thus, a South Dakota study assumed the average net farm income of 1920–1940 to be normal.[3] It should be apparent that ordinarily there is little merit in assuming the current earning power to be the true earning power. Between 1910 and 1940, the current earning power of the Iowa land fluctuated from $4.30 to $7.62 per acre. There would be more merit in using the earnings of a particular period if it were possible to choose one. From the series of years shown in Chart 103 in the last chapter, it would appear that the most nearly stable period was from 1935 to 1940. But farm earnings are usually considered to have been very low in these years. The next possible choice would be to take the average of the years 1925 to 1929.

TEMPORARY CHANGES IN INCOME Even if one chooses some period as normal and bases his valuations upon it, series of years of unusually high or low earnings would develop from time to time. Even though these are only temporary, they do affect the current value of the land. If at the onset of the present war in December, 1941, a farmer was considering the purchase of a farm, he could well afford to pay for the expected larger income of the war years only. Take the farm assumed above that had been producing $500 annually as net rent, which, with interest rates assumed to be 4 per cent, had a value of $12,500. Suppose that he were to forecast that the most likely net income in 1942 would be $800; in 1943, $1,000; in 1944, $1,200; in 1945, $1,200; in 1946, $1,000; in 1947, $700, and $500 again annually thereafter. How much extra could he afford to pay for this farm in 1941 because of these temporary higher incomes? The formula for determining the present worth of a single year's income expected sometime in the future is as follows:

$$\text{(III)} \qquad PV = \frac{a}{(1 + r)^n}$$

where n equals the number of years before it is received. According to this formula, the value in 1941 of the $300 extra expected in 1942 would be $288; that of the $500 extra due in two years, $462; of $700 due in three years, $622; of $700 due in four years, $598; of $500 due in five years, $411; and of $200 due in six years, $158.[4] The total present worth of these added incomes would have been $2,540 in 1941. The prospective

[3] Norris J. Anderson, *What Price for This Land?*, South Dakota Bull. 368, 1943.

[4] To apply this formula by arithmetic requires a good deal of figuring, but almost any bank is likely to have a table showing the present worth of a dollar at different interest rates received in different years in the future.

buyer would therefore have been justified in paying $15,040 for this farm. After each year of the war, however, the farm would be worth less because part of the temporary incomes had already been received. After 1945, less than $700 of it would have been left.

Contrariwise, if this same farmer had been thinking of buying this farm in 1929 and could have anticipated the greatly reduced income of the years immediately following, he surely would have wanted to reduce his bid on the farm.

INTEREST RATES So far, we have been talking primarily about the income stream. Equally important, though often neglected, is the matter of the appropriate interest rate. At any given time, several interest rates are being paid, depending upon the degree of risk involved in the investment and the amount of servicing required. Choice of the most appropriate rate is not easy. However well the rate may be chosen, it is not likely to remain unchanged for indefinite periods. Historically, interest rates have fallen in the United States. Our frontier was always an area of high interest rates — 10 per cent, 15, 20, and even higher rates were often charged. As each area became more fully developed, and as the supply of capital increased, interest rates in the frontier areas fell relative to interest rates in the large Eastern cities. As late as 1920, however, the usual interest rate on long-term farm mortgages was around 8 per cent in several Western states. The rate of interest has also fallen in the economically most advanced areas. The decline in interest rates has been particularly marked since 1930, and has carried the interest rate to levels previously believed impossible. By 1944, one of the largest life insurance companies was writing farm mortgages at 4 per cent interest. Considering the costs involved in handling mortgages, this company would receive not more than 3 per cent interest on its investment.

The effect of changes in interest rates upon the present value of a durable asset is often not appreciated. A reduction in interest rate from 6 to 4 per cent adds 50 per cent to the value of the asset, other factors remaining unchanged. A reduction from 5 to 4 per cent adds 25 per cent to values, and from 4 to 3 per cent adds 33 per cent to values. The effect of a change in interest rate should be fully as great as the effect of differences in income, but in practice it is not likely to be, since the agricultural public is disposed to be slow in adjusting its land value attitudes to changing interest rates. If all farm real estate value had been actually on a 4-to-6 interest-rate basis in 1940, instead of the 5-to-8 rate that prevailed in 1930, the $\frac{1}{r^2}$ in the formula would have

needed to be a negative quantity to give the interest rates then prevailing.[5]

FARM BUILDINGS As explained in Chapter XXIV, buildings differ from land in that they are eventually used up and hence do not yield an income in perpetuity. Their value gradually declines as their remaining productive life diminishes. At any time, their value is limited by replacement costs. Temporarily, their value may rise above replacement cost, either because of the time involved in constructing a new improvement, or because for the time being it may be impossible to construct the improvement. The latter was true in wartime. Contrariwise, the value of buildings or other improvements may fall much below replacement cost if anticipated future incomes decline for any reason. The valuation formula for buildings, therefore, is that of a *terminable income bearer*, or

$$PV = \frac{a(1 - r)^{n-1}}{r(1 - r)^n} \tag{IV}$$

in which n equals the number of years for which the income runs. This formula is therefore like that for land except that it takes account of the number of years.

In practice, however, farm buildings may not be appraised separately from farm land. The reason for this is that farm buildings, once they are incorporated with the land, ordinarily have no value except that which they contribute to the net farm income. In the determinations of net cash rent in the analysis above, depreciation and repairs of buildings were subtracted from gross cash rent along with taxes, on the assumption that such depreciation and repairs are necessary expenses connected with the use of the land and must be met if the land is to continue in use. Often this is not a valid assumption. Changes in systems of farming may make certain buildings of very little value; for example, when an area goes out of tobacco growing, or out of livestock farming into truck farming. Buildings may also lose value through obsolescence, that is, they become no longer suited to modern methods of farming. Conversely, an area may find itself with inadequate buildings when dairying is expanding rapidly in it.

The tendency of many appraisers is to value farm buildings on the basis of cost of reproduction now, less depreciation down to date. Farmers also tend to report such values to census enumerators. As a result, the buildings on some farms may appear to be worth more than

[5] A careful recent analysis has shown that interest rates on farm real-estate mortgage declined $1\frac{1}{2}$ per cent in the United States between 1930 and 1940.

the whole farm. Enough farms answered such a description in the Northeast from 1880 on to 1910 so that the land in farms appeared to have very little value in the census reports. This same result appeared over most of the country after 1920, when building costs virtually doubled and net farm incomes declined. Such valuations of farm buildings are spurious. The buildings are worth no more than what one *could afford to spend on new buildings now*, less depreciation down to date, making such allowances as seem warranted for expected increases in net farm incomes.[6] The levels of prices of farm products that prevailed in 1920–1940 did not furnish an economic basis for investments in buildings at the level of their costs in these decades. In effect, buyers of farm products in this country are now cashing in on building investments made before 1920 when wage levels and building costs were less than half what they are now.

The result of the foregoing is that any valuation of farm buildings at cost of reproduction now less depreciation down to date gives a value out of proportion to what these buildings are now contributing to farm income. Correlation analyses used as a basis for appraisal in the late 1930's commonly showed that a dollar of building values per acre appraised on a reproduction basis added only from 60 to 80 cents per acre to the value of the land. In 1918–1920, the opposite tended to be true because building costs had not yet risen to the new price levels and buildings tended to be appraised on the basis of earlier costs. It is difficult to forecast what will happen from now on, but it may very well be that prices of farm products will in due time be high enough to underwrite investments in new buildings at the levels of costs which will then prevail. At any rate, in the long run, prices of farm products must be high enough to finance the construction of farm buildings.

LAND IMPROVEMENTS The foregoing statements apply to land improvements about as much as they do to buildings except that land improvements vary greatly in life-span. Some are used up in a few years, like lime and phosphate, and others last so long that they really become part of the land — underground drainage, for example. In practice, income from land improvements is included along with the buildings in almost all farms of appraisals. Serious errors are introduced in this way, however, in situations in which the land improvements are being used up very rapidly as a result of overcropping or misuse. Net rents on many cash-rented farms are figured too high because not enough is deducted for depreciation of the land improvements as well as of the buildings.

[6] See further discussion of this in Chapter XXXIV.

It follows from the foregoing that future incomes from buildings and land improvements are as uncertain as are those of the land itself. Their values are based on expectations of future incomes which may not be realized if the buildings or improvements become obsolescent. The same result can follow if the improvements have the effect of increasing output more rapidly than demand expands to meet it.

THE PRICING PROCESS FOR FARMS

The value of land, it is now evident, must not be thought of as merely something inherent in its physical properties. It depends also upon the demand for the product of the land; land which is highly productive so far as physical yields are concerned will have little value unless the crop is one which has an important human use. Even more important, the value of land and buildings is derived from *expectations of income* and not actual income. It follows, then, that values change as expectations change, not necessarily as incomes change. Present expectations may or may not be later realized.

Equally important, farm real-estate values are not based upon the expectations of any one person, but instead on the expectations of all those who have enough interest in it so that they can be said to be in the farm real-estate market. The expectations of these different persons are ordinarily spread over a wide range all the way from sizable declines to sizable increases. This surely was true, for example, of the expectations of different persons in 1944 and 1945 as to what farm incomes would be five or ten years after the war. Those who are potential buyers have a range of expectations that fits into a schedule much like the demand schedule for commodities. Those with high expectations of future incomes are potential buyers of farms at high prices, and those with low expectations, of land at low prices. Those who are potential sellers have a range or schedule much like the conventional supply schedule for commodities. At the point where these two schedules intersect, the prevailing level of land values is established. This is the market price or market *value* of farm real estate. *This market value of farm real estate therefore represents a certain level of expectations.* This level fluctuates greatly in periods such as those through which we have been passing in the last two or three decades. It does reflect the earnings of land and buildings, but only because these earnings affect expectations.[7]

[7] A study of 850 farms in the wheat area of Idaho brought out the interesting fact that the net incomes of the land rented on shares, one third to the landlord, seemed to determine the prices of farms much more than the net incomes of owner operators. A. N. Nybroten, Idaho Bull. 248, 1942.

APPRAISAL OF FARMS

We are now in a better position to understand appraisal practice and procedure. It should now be clearer than before why the value of a farm determined by an appraisal depends upon the purpose it is to serve.

MARKET VALUE One such purpose, but only one, is to arrive at market value, that is, the price at which the farm would sell if it were placed on the market and sold under ordinary conditions (not at forced sale).[8] This is the value which the census enumerator undertakes to obtain when he visits each farm in the United States every five years; the value wanted when an estate is settled, or by an insurance company when it is selling farms which it has acquired through foreclosure; or that a farmer wants when he is preparing an inventory, except in periods of highly variable prices.

Given this purpose, the objective is to find out what farms just like this one are selling for at the time in the area. The usual procedure for this is to rely upon the judgment of those who are most closely in touch with the farm real-estate market — the bankers, the real-estate brokers, and the like. The reasoning which these persons follow is very simple, much like the following: Fred Wagner's farm sold for $120 per acre last year, George Ward's for $140 per acre. Your farm has better buildings than the Wagner farm, and a little more cropland, and the cropland is a little better on the whole. But it is not quite so good a farm as the Ward farm on all these counts. Its value therefore ought to be around $135 per acre.

This method is often called the method of the "experienced guess." It can be refined by collecting data on selling prices, and on the major facts about a considerable number of farms sold in the area within the last few years. These data may show the differences in yields of the farms sold, in the percentage of land which is tillable, in the value of buildings per acre, in the type of road upon which the farms are located, in the distance of the farms from town, and other factors that may be important. Statistical analysis of these data may show that for this group of farms each additional mile distant from town has on the average decreased values by $5 per acre; that farms on hard-surface roads average $12 more per acre than those on gravel roads, and $20 more per acre than those on dirt roads; that each additional 10 per cent in percentage of

[8] Occasionally a situation arises in which the value wanted is the forced-sale or liquidation value.

the farm land tillable adds $5 per acre, and each ten units in the crop-yield index $4 per acre. Such analysis may also show that $10 of building value per acre adds more or less than $10 per acre to the value of the land depending upon whether the area as a whole is underbuilt or overbuilt.[9] Obviously, individual farmers cannot engage in this type of analysis, but agricultural experiment stations can do so.

Even this careful procedure may not establish the true relative value of the farms in an area. Usually some factors are present which cannot be reduced to statistical measures, such as residential values as distinguished from production values. In general, well-managed farms in good condition are overvalued relative to those which are temporarily suffering because of negligence of tenants or of owners under distress.

LOAN VALUE In the past, with the annual earnings of farms fluctuating as much as they have since 1910, it has not been safe for farmers and lending agencies to base appraisals on the assumption that prevailing incomes would continue indefinitely, and certainly not on the assumption of steady increases in net incomes. It will continue to be unsafe until such time as our society becomes more stable, with no threat of wars on the visible horizon and with the major recessions of business under control.

It should be obvious that in the uncertain world of the present, no such thing as a "scientific" determination of loan value is possible. Any procedures that may be adopted for establishing a loan value of a farm are nothing more than expedients. The procedure that seems most expedient at present is to base loan values of farms on a conservative forecast of a regular constant income year after year, with a cautious adjustment upward and downward for temporary aberrations due to wars, depressions, and the like, and still more cautious adjustment for changes in the income level in the future. The margin of safety of 50 + 20 provided in the Farm Credit Act of 1935 was intended in part to protect the F C A and the borrower from possible declines in market values of farms below a level determined on the foregoing conservative basis. The appraisal blanks ask for two kinds of value, the first of which is the equivalent of market value as above described, and the second of which is "normal" value, which is based on "average production and normal prices of farm products."

The manual of the Farm Credit Administration defines *normal value* as follows: "The normal agricultural value of a farm may be defined as the amount a purchaser who is representative of the area and type

[9] G. C. Haas, *Sale Price as a Basis for Farm Land Appraisal*, Minnesota Tech. Bull. 9, 1923.

of farm would be willing to pay and would be justified in paying for the property for agricultural purposes, including farm home advantages, under usual conditions based on average production and normal prices for farm products." The market values are supposedly asked for only in order to show the amount of the spread between market value and normal value. The loans recommended by the Farm Loan Associations are supposed to be based on *normal value* and not on the market values.

But what is the *normal price* for wheat at any time? or of cotton? It cannot be established scientifically by any method of averaging; the average price of cotton in the next ten years need have no close relation to what it was in the last ten years. Changes in the general level of all prices or of farm prices, or in the technique of production of particular crops, affect the average price for any one commodity very greatly. The normal prices used by the F C A are definite stated prices which are changed only at intervals. In particular, they are not changed in wartime when farm earnings are temporarily very high. The F C A assumed during the war that prices of farm products would return sometime after the war to about their prewar levels. The more important normal prices used during the war in establishing loan values by the appraisers of the F C A were as follows: Per bushel: wheat, \$.77; corn, \$.58; oats, \$.32; potatoes, \$.58. Per ton: hay, \$9.00; cottonseed, \$25.00; peanuts, \$56.00. Per cwt.: hogs, \$6.25; cattle, \$5.50; lambs, \$7.00; milk, \$1.80. Per pound: cotton, \$.10; butterfat, \$.28; wool, \$.23. The normal prices for the full list of crops averaged 7 per cent below the average price of these products in 1909–1914; for all livestock, 4.5 per cent above the 1909–1914 level. These normal prices were mostly established in 1936. A few changes were introduced afterward to take account of changing demands and techniques of production. No general rule has been laid down as to when these normal prices are to be changed. The best that one can say is that the changes will ordinarily lag behind changes in farm earnings by five to ten years.

In the meantime, other loan agencies may not lag as much and they may take loans away from the F C A increasingly, especially loans in which the size of the mortgage is a major consideration. If one agency decides to be highly conservative, the loans will be written by others not disposed to be so conservative — that is, unless they enter into agreements with each other, and no agreements of this kind can include the loans made by individuals. Private individuals rarely have any carefully defined loan policy and are likely to increase their loans soonest. By the middle of 1944, the average size of the mortgage loans made by the F C A had risen only 9 per cent above the prewar level; of the insur-

assessed at a certain level that seems to have been maintained for some time and he contents himself with keeping the different properties under his jurisdiction in their right relative position. If a new house is built in his territory which cost $10,000, including $1,500 for the lot, he is likely to assess it at around $7,500.

As a result of these loose practices in establishing assessed values, much inequity has resulted between different classes of property, and this has contributed to tax delinquency. Some state tax commissions have given a good deal of attention to this problem. One method followed is to attempt to establish county by county the average departure of assessed values from sales values and to raise the assessed values in each county according to the percentage of departure.

The most serious consequences of inadequate assessment in farming areas develop when shifts take place in the use of land. Much land in the West, for example, was assessed on the basis of yields of wheat obtained in series of years with good rainfall. When it became evident that this land never should have been plowed but should be returned to ranching, it proved very difficult to lower the assessed values. The same lag in the South stands in the way of shifting land out of cotton into more extensive uses. Rather generally, the poorer grades of land in an area are assessed at too high values. This contributes to their increasing tax delinquency. At the same time, it keeps potential timberland operators or ranchers in the West from buying them.

SPECIAL CLASSES OF FARM PROPERTY

The remaining problems of valuation will be best understood if presented in terms of particular types of farm property.

ORCHARDS Some of the most interesting phases of farm property valuation are illustrated by the case of orchards.[12] At the start, an orchard is increasing in value because it is receiving additional inputs of labor and materials, but it has no income. Then comes a period when it yields an income, but the annual expenses exceed the annual receipts. In the third stage, its *net* income is increasing. In its fourth stage, the net income is decreasing. When the net income becomes zero again, the trees are replaced. The problem of valuation of an orchard is to determine its value at any point in these different stages. The land, or site, and the trees need to be considered separately and combined. The value of the site before the trees are planted, or when the trees are ready to be re-

[12] The analysis under this head is based largely on a study by H. C. Woodworth and G. F. Potter, *Studies in Economics of Apple Orcharding*, III, New Hampshire Bull. 323, 1940.

placed, must be based on the anticipated income of the land devoted to orchard or other competing use. To obtain the value of the site for orchard use, the *average* net income for the whole life-span of the orchard is inserted in Formula I, or in Formula II if future incomes promise to be more or less than those now prevailing. At other stages, the value of the trees and the land combined is the sum of the future net incomes of the orchard discounted down to date by Formula III. Formulas I and II cannot be used for this because the net incomes from the trees vary with the age of the trees.

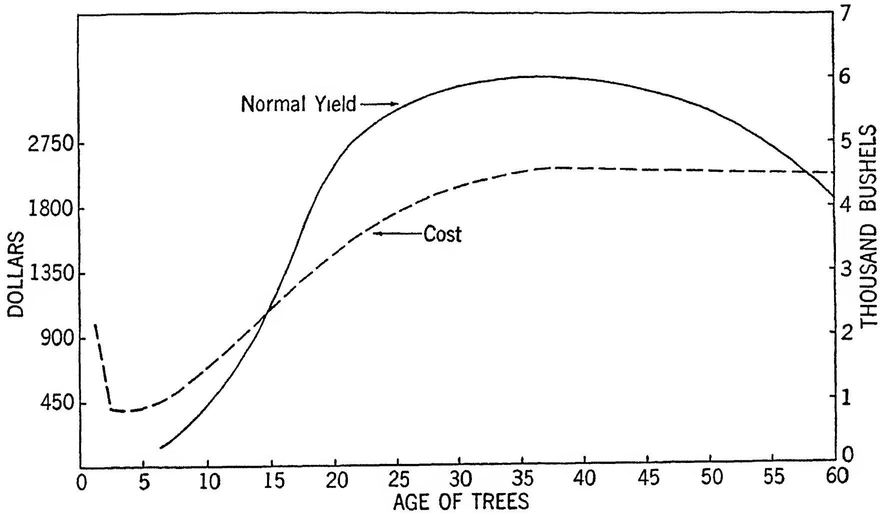

CHART 105. Costs and receipts per 1,000 trees at different ages with apples at $.60 per bushel on the tree. (Based on Figures 6 and 7 in New Hampshire Bull. 323, *Studies in the Economics of Apple Orcharding*, by H. C. Woodworth and G. F. Potter.)

Chart 105 shows the annual costs of planting and care of the orchard, and the gross income at 60 cents per bushel net after harvesting and marketing costs, per 1,000 apple trees on some New Hampshire orchards before the war. The planting of the trees and their protection involve heavy costs the first year; thereafter, the costs are relatively low for a few years, then rise rapidly until the trees reach 35 or 40 years of age, at which level they remain until the trees are removed. Most of the various items of cost exhibit this same pattern, though the labor costs rise more rapidly than the materials costs. The yields of these orchards reach their peak at 35 years.

The first net income, with apples at 60 cents per bushel, appears at 12 years. The peak in net income is reached at 30 years. When these

net incomes are discounted down to date at 5 per cent interest, according to Formula III, they produce the upper curve in Chart 106. The value of the orchard as measured by these discounted future net earnings rises steadily and sharply to a maximum when the trees are 20 to 25 years of age. This is nearly ten years before the net earnings reach their maxima. An orchard is not at its most valuable age when its net income is the highest, but at the age when it enters into the period of relatively high net earnings. Because there are several profitable years

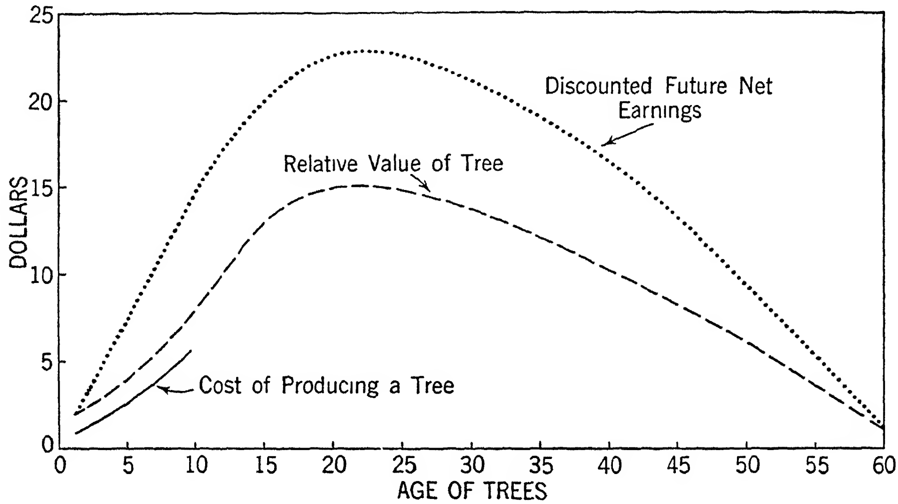

CHART 106. Present worth of future incomes from the orchard, and inventory value of the trees, per 1,000 trees. Also, tree costs for the first 10 years. (Based on Figure 17 in New Hampshire Bull. 331.)

ahead, the buyer can afford to pay well for an orchard 20 to 25 years of age. By the time the peak annual earnings have been reached, the value is on the decline because the largest incomes have already been received. When the trees are 45 years old, their net earnings are still high but their value has declined greatly; the end of their productive life is in sight.

The probable market value of the trees is better indicated, however, by the lower curve in the chart. Buyers of orchards will seldom pay the full discounted value of the future earnings. H. C. Woodworth and G. F. Potter write, "The future annual net incomes, many of which are some distance in the future, are dependent upon continuous skilled attention and management, a situation too illusive and insecure to warrant one's paying for an orchard on the basis of the total future net

earnings discounted." One man could scarcely ever plant and care for an orchard during its entire productive life, and a change in operatorship might mean considerable loss in managerial skill.

It will be noted, on the other hand, that the value placed on the apple tree is higher than the cost of producing it. This assumes that buyers will pay something more than cost of replacement for trees already in production.

This example may serve to illustrate the general principle that replacement costs may need to be considered in valuation of capital goods as well as the discounted future net earnings. If the latter were perfectly predictable and absolutely sure of attainment, they would in the long run exactly equal the cost of their replacement. Anyone seeking to purchase property of this kind would have the alternative of buying that in existence or of producing it anew. With incomes varying, there may be periods when the discounted net earnings are either greater or less than the replacement cost. The replacement costs of farm buildings have been generally higher than their net incomes since the First World War, because wages of construction labor and prices of building material have been higher relatively than prices of farm products.

Woodworth and Potter carefully label the value curve in Chart 106 as "relative value." They do not want it to be taken as indicating the actual value of apple trees in New Hampshire, since these exhibit a wide range dependent upon site, management, variety, and several other factors. If the curve is understood as indicating the general shape of the curve of values according to age, it is applicable to other areas, and even to other species with adjustments for age at maturity and life-span.

LIVESTOCK The valuation of productive livestock presents a set of relationships very similar to those for orchards. As was pointed out in Chapter XXIV, a milk cow's value is greatest near the beginning of her productive life, not at the peak of her production, for the same reason that the orchard is most valuable before it reaches peak production. There is always the risk that heifers will not live, as well as the chance that they will not prove to be profitable and will have to be culled out after their first freshening.

The same general principles, with some modifications, apply to breeding stock on a cattle ranch. The cows have a value as breeders, in excess of their value as animals to be fattened, which value rises to a peak and then declines as with milk cows. Some ranchers, however, inventory their breeding herds pretty much as if they were animals to be fattened. They change their valuations from year to year with the market prices of

beef. This method may at times produce large apparent profits or losses. The value of the cattle on a ranch may easily be half of the total ranch value. If this half of the ranch value moves up and down sharply the losses or gains will be relatively large.

Some ranchers have gone to the other extreme and carried their breeding stock at constant inventory values, regardless of market prices for cattle. They argue that over a long period of years it will cost $50 per head, or some other figure, to produce a mature beef cow and that she will on the average be worth $50. This method fails to allow for the long-sustained fluctuations in income that characterize beef-cattle production.

The most realistic procedure is to use the long-term average value of breeding animals as a base, and to adjust these values from time to time in accordance with *income prospects* for the period just ahead. If a stretch of years of low beef prices is in sight, the value of breeding animals may be less than their market value. If a period of relatively high prices is in prospect, the value of the breeding animal may rise above the long-term average temporarily.

FEED The same valuation problem exists for farm-raised feed for farm consumption as for breeding animals. When hay is raised and fed on the farm, its value arises solely from the livestock production it makes possible. When the hay crop is generally short in an area, hay prices rise. This is an inducement to the farmer to sell his hay, and to use his available supply frugally. But the hay which he must feed to his livestock in order to remain in the business should not be valued higher than the livestock prices will warrant. Since the farm as a whole is a going concern, the production from the hay part of the business cannot be valued higher than the livestock part of the business can support. Higher prices for hay are realizable only if the livestock are liquidated. This is ordinarily unprofitable from a long-run viewpoint, if there is sufficient feed to pull the animals through the feeding season.

USE OF PUBLIC GRAZING LAND A major part of the public range lands in the West are worthless without complementary privately owned land which produces feed for other seasons, and the private lands are often of limited value without the public lands. The combination of the two can be valued without difficulty according to the principles outlined in this chapter. The problem is that of dividing the capitalizable income between the public and private lands. All public lands in the West went through an extended period of free use during which values derived in part from them became attached to the associated privately owned

land. Even today, administrative decisions as to grazing fees determine the amount of income going to public land, and the rest goes to the owner of private land. Use of public lands does not attach permanently to particular tracts of private land, but the income has generally been capitalized as though it did. When the use of public land has been lost, severe losses in value have resulted.

The simplest method of arriving at a valuation of public range land that truly reflects its contribution to income is to base it on the annual rentals paid for private land. But where a major part of the range available for any seasonal use is publicly owned, the rentals paid for public land establish the level for private lands also. Under these circumstances, the most equitable procedure is to construct budgets of typical ranch operations, calculate the total capitalizable income, and divide it among the various types of land on the basis of the proportion of the year the livestock are fed or grazed on each. Some adjustments may need to be made for extra or unusual costs involved in operations on particular tracts and perhaps for lack of permanency in the use of public land.

FURTHER READING

*G. H. Aull and Ernest Riley, *Some Inequalities in the Assessment of Farm Real Estate in South Carolina*, South Carolina Bull. 313, 1938.

Social Science Research Council, *Research in Farm Real Estate Values, Scope and Method*, Bull. 19, 1933.

Mark A. Shipley, C. E. Fleming, and Bryant S. Martineau, *Estimating the Value of Range Forage for Grazing Use by Means of an Animal-Unit-Month Factor Table*, Nevada Bull. 160, 1942.

*H. H. Lord, S. W. Voelker, and L. F. Gieseker, *Standards and Procedure for Classification and Valuation of Land for Assessment Purposes*, Montana Bull. 404, 1942.

Dudley E. Young, Marvin A. Brooker, and Frank J. Welch, *Rural Land Market Activity in Mississippi*, Mississippi Bull. 406, 1944.

EXERCISES

1. For a particular cash-rented farm in your area for which data are available, determine *PV* using Formula II.
2. If the cash rentals paid each year since 1940 are available, calculate its value in 1940 using Formula III.
3. Calculate *PV* for an owner-operated farm in your community. Compare the results with the market value of the farm.
4. Calculate the loan value of this same farm, using the "normal prices" of the F C A.
5. How would you value the buildings on a farm where the total sale price was approximately equal to the replacement cost of the buildings?
6. Ascertain how market and assessed values compare in your county.

CHAPTER XXXIV

Buying or Renting a Farm

THE ANALYSIS IN THE PRECEDING CHAPTERS HAS ASSUMED A FARMER already in the possession of a farm, either as owner or tenant, and has dealt with the problems of planning, organizing, and operating this farm. This is the usual form in which management decisions present themselves to farmers. But we have noted elsewhere that in 1940 the average owner-operator had been on his present farm seventeen years, taking the country as a whole. This means that one farmer in seventeen in the average year around 1940 was looking for a farm on which either to start in as an owner or to take the place of one he had just sold. Similarly, one cash or share tenant in six was looking for a farm to rent; and one cropper in four. The purpose of this present chapter is to consider the problems connected with selecting a farm on such occasions and arranging for its purchase or lease. In the aggregate, these problems bulk large among the various tasks coming under the head of farm management.

THE FARM REAL-ESTATE MARKET

Although most farmers do not realize it when they set forth to buy or lease a farm, they are entering a market just as much as if they were setting forth to buy feed, fertilizer, feeder cattle, dairy cows, or machinery and equipment. The major difference is that the farm real-estate market is not well organized — in other words, it is far from being a "perfect market." The essential character of a highly organized or perfect market is that everyone in it knows exactly what is happening at all times, and as a result identical commodities or other items sell for exactly the same price at any one time. The commodities can differ in type, quality, or grade, but these differences are so thoroughly understood by everybody that the prices precisely represent the differences in grade. The transactions may take place in different parts of the market, as sometimes they do in different parts of the farmers' produce market; but if the market

is perfect, these transactions will be known to everybody so that the same grade of product sells at the same price in all parts of it.

The farm real-estate market falls short of being a perfect market in that the buyers and sellers of land have inaccurate knowledge of the differences in quality of the farms being bought and sold, since there is no common system of grades by which they can be judged, and because they are not generally well informed concerning the transactions that are taking place. As a result, farms are frequently sold for more or less than the going price, taking account of differences in productivity, residential advantages, and related factors. It is easily possible, therefore, to pay too much or too little in buying a farm; likewise, too much or too little rent.

It is even more important to keep in mind that any market price tends to represent a sort of consensus of all the buyers and sellers in the market. It is more than some buyers are able or willing to pay, and less than others would or could pay if they had to. Similarly, it is less than some sellers would take for their farms and more than enough to induce others to sell their farms. In the familiar language of the textbooks in economics, there are always *excluded* buyers and *excluded* sellers; that is, those not willing or able to buy or sell at the price that comes to prevail. Thus it happens that the price at which a particular farm sells is likely to be more than other potential buyers would have been willing to pay for it or should pay for it. At the same time, the ones who do buy it might have been willing to pay more for it if this were necessary.

The various potential buyers of farms bid differently partly because they have different means with which to buy, partly because they have command of different working capital to use on the farm — livestock, equipment, etc. — and partly because of differences in their ability as managers. As carefully explained in Chapter XVIII, the more capable farmers are able, if necessary, to outbid the less capable for the better farms.

It follows from the foregoing that anyone buying or renting a farm needs to watch carefully to see that he does not bid too much for a particular farm, and on the other hand that he bids enough to get as large a farm and as productive a farm as matches his particular capacity and efficiency.

SELECTING A FARM

We now come to the specific task of a particular farmer selecting a farm for himself. Such a farmer needs to consider such questions as the kind or type of farming in which he wishes to engage; the particular

region, section, area, or community in which he wishes to farm; the location with respect to markets, cities, and roads; the size of the farm; the combination of plowland, pasture, woodland, upland, and lowland; the types of soil and topography; the dwelling and farm buildings; the water supply; the schools and other social factors; and above all, always the relation of these to price. Each of these considerations can be discussed in much detail. Most of what would be written, however, would be so familiar and obvious that it would have little value. The principles involved have all been clearly presented. What remains is only to point out a few applications that might otherwise be overlooked.

IN WHAT REGION AND AREA TO FARM, AND WHAT KIND OF FARMING

This is no question for most young men who want to buy or rent a farm. They will want to select a farm in the region and area which they know best, and practice the kind of farming which they learned on the home farm. This is as it should be, because in this way they will be able to use their knowledge and experience to best advantage and get the most help and companionship from relatives and friends. But there are some important exceptions to this general rule that need to be analyzed briefly. The following are a few of these:

1. Most important of all, the usual farm is altogether too small in many sections of the country, and it will be better for a prospective farmer not to farm at all than to take over one of these inadequate farms except as a stopgap in a period of unemployment. He should either find a farm which is large enough or try to enlarge his present farm by buying additional land within a reasonable distance, or go somewhere else to farm, or quit farming altogether. There is no sense in further crowding an area that is already overcrowded. Although 80 acres would be better, even a 40-acre farm in the Midwest dairy area offers a better opportunity than a majority of the cotton and tobacco farms of the South. The difficulty is that most farmers in the South do not know enough about dairy farming to succeed with it anywhere, to say nothing about practicing it in a new environment. Some of the border states like Tennessee, Kentucky, and Missouri are also very crowded, however, and many of their farmers know enough about caring for livestock so that they could succeed with it elsewhere.
2. An increasing number of families are going to live on small farms near cities and other places of nonagricultural employment and practice part-time farming. As workdays and work weeks are shortened, and as transportation and electric light and power and other

facilities improve, they will look for these part-time farming opportunities near their jobs. Some families will also want to combine such farming with the operation of garages, filling stations, roadside stands, and the like, and the choice of a site for these will determine the best place to locate their farm.

3. New lands are still being opened up as a result of irrigation, drainage, and flood control developments, and these may offer better opportunities for some young farmers than established communities in which the land is closely held.
4. A very few frontiers are still open to young men with the necessary resources and the right kind of enterprise. These are areas where undeveloped land can be purchased and made into farming enterprises of one kind or another. These are mostly in the so-called cut-over regions, and they commonly offer opportunities to practice combined farming and wood-lot operations. (See Chapter XLVII for a further discussion of these.) Opportunities also exist to rehabilitate some farms in older areas that have been allowed to run down. Modern techniques of pasture improvement and land clearing are making successful operation increasingly possible in carefully selected areas, especially in areas in the Northeast that have been allowed to run down in recent decades.
5. A city or village may provide a local market for fluid milk and cream, strictly fresh eggs, locally grown vegetables and fruits and the like. These communities may not be adequately supplied at present, and the farmer wanting to engage in these types of farming may find a better opportunity near such cities than in the larger established dairy, poultry, and truck-crop areas. This is particularly likely to be true around some cities in the South, in the Corn Belt, and on the eastern edge of the small-grain area.
6. There may be similar opportunities around developing summer recreational areas or new industrial communities.
7. The land in some parts of an area may differ from that of the area as a whole and need to be farmed differently from it. This provides an opportunity for farmers from other areas who know how to handle this kind of land to obtain it more cheaply than they can obtain farms in the areas mostly given over to such a type of farming. If the product is one which needs special marketing facilities, this phase of the matter needs to be looked into very carefully.[1]

[1] As an example, the resurvey of Rhode Island soils disclosed several thousand acres of Bridghampton soils as good for potatoes as the Caribou silt loams of Maine and much nearer to market.

8. A very important exception to the general rule is that the territory with which the farmer is familiar may be shifting from one type of farming to another; for example, from cash-grain farming to crop-and-livestock farming, or from beef cattle and hogs to dairy and hogs, or from cotton to diversified farming. The farmer needs to consider very carefully the type of farming that is likely to prevail in such an area and choose his farm accordingly. If he does not know very well the type of farming that is coming in, it may be necessary for him to learn it. Young farmers can ordinarily do this. The older farmers seldom can. Thus, when a territory in northwestern Wisconsin east of the Twin Cities was shifting from small grain and "red cow" farming to dairy farming with Holstein cattle mostly, the older farmers in the area proved unable to change. Dairy farming developed in the area by an influx of dairy farmers from southern Wisconsin, and the young men learned dairy farming from their new neighbors. Somewhat the same thing happened in the Red River Valley of Minnesota and North Dakota a few decades later.
9. Frequently it is necessary to modify somewhat the prevailing system of farming in an area to satisfy the particular combination of types of land found on a particular farm. Altogether too many farmers in some parts of Iowa undertake to practice a corn-and-hog system of farming without regard to the fact that much of their land is too sloping to lend itself to successful operation on this basis. Altogether too many farmers try to practice corn-and-hog farming on the hardpan soils of southern Illinois.
10. Because of not having enough land to utilize the family labor supply and inability to obtain additional land, it may be highly desirable for some families to practice a more intensive system of farming than is common in the area.

Surely the types of decisions that are involved in the foregoing are of major importance. It is extremely easy for a farmer to make a mistake in such a matter. He should take all the time he needs in order to arrive at a wise course of action. A month or two spent in careful analysis of such a problem may mean more than years of hard work afterwards. This problem is especially important at present because an unusual amount of moving about of younger farmers is following the war. Some of this arises because young men have married into families living in other areas or regions; more of it because young men were stationed in other parts of the country than their own and have become acquainted with opportunities elsewhere.

If a young man is considering transferring into an area different from

that in which he was born and reared, he needs to take time to learn everything he can about farming in the new area. He should spend considerable time visiting and traveling over the area and contacting the county agent, the banker, the merchants, and everybody who can help him. Market outlets are especially important to explore carefully.

If a young man is doubtful as to the part of the country in which he wants to farm, he should obtain all the help that he can concerning farming opportunities from the United States Department of Agriculture and the agricultural colleges and extension services in the different states. He should ask the extension services in the states that he is especially considering to supply him with all the bulletins and other material that will be helpful to him. (A few of the bulletins that deal especially with this problem are listed at the end of this chapter.) Then he should study carefully the soil survey for the area in which he is locating, if it has been surveyed. Finally, he should make up as good a budget of probable receipts and expenses and net incomes as he possibly can for any farm that he is especially considering. He should interview enough local persons and get the necessary data to make as dependable a budget as possible.

Finally, it is an excellent idea to rent a farm for a few years in the area so as to have time to learn all he can about it and to select a farm very carefully.

A final caution is to avoid dealing with land selling agencies that specialize in helping farmers to buy farms in distant areas, because they are highly practiced in the art of seducing unwily persons into believing that these distant areas offer remarkable opportunities.

WHERE TO LOCATE IN ANY AREA It is easy to say that the farm should be located on a good highway not too far from an enterprising city. But such farms are likely to be in the hands of established families and to be relatively high priced, and a farmer may find it much better to put his money in other than residential values. Reasonably good all-weather crossroads may suffice for all practical purposes. Locations which are not on all-weather roads at present, but which stand a good chance of getting such roads as our road system is expanded, should be considered very carefully. It is, of course, possible to buy a farm that is too isolated from others — too far back in the woods or back up in the hills — so that it will be difficult to get the milk out every day in the winter, or on very muddy days in the spring, or to get the children to school. *The important consideration is whether the farm in question is located in an area where farming is declining or has prospects of improving.*

Special types of farming, like truck farming, of course, may make location near to market highly important. Roadside stands need to be on traveled highways, and dairy farms within reach of creameries.

SOILS, TOPOGRAPHY, AND CLIMATE It is equally easy to say that the land in a farm should have good soils, be relatively free from stones, well drained but not too well drained, and not too sloping or hilly; that it should have a relatively long growing season so as not to make the winter feeding problem too difficult; and that it must have enough rainfall to produce crops. One might then add something about air drainage and protection from late frosts in the case of orchard and fruit farming.

But the facts are that the major portion of the land now farmed in this country, and a larger fraction of it in the Old World, does not measure up to these specifications. More farming in the world is done on fair to poor soils than on good to excellent soils; more on sloping land than on level land.[2] Probably more is done on semiarid land than on semihumid land, although probably the latter produces more than half of the food and fiber of the world. The main job of agriculture is to take land which is inferior in various respects, find out the use to which it is best adapted, and then learn how to make it produce; to take soils which are defective and deficient in important respects and make them productive. This sort of a task is required even within the boundaries of a majority of individual farms because they are likely to contain much land which has important defects of one kind or another. *When land is so used, the qualitative differences between farms become largely quantitative.* More acres are needed of the poorer lands than of the better lands in order to give enough command of productivity to produce an adequate farm income. But given enough of such land, the income may be just as adequate. This is clear enough in the case of semiarid lands that have to be used for extensive small-grain crops and grazing. It is equally important in the case of lands that are relatively unproductive for other reasons.

Unfortunately, however, except in the semiarid regions, the farms tend to be smaller in sections of poor soils than in sections of highly productive soils. The highly productive lands tend to pass into the hands of well-to-do persons who operate them in sizable units or rent them to tenants with whom they are able to share the income. The less well-to-do tend to crowd themselves into the remaining lands and divide them into too small units.

[2] The terms *poor land* and *good land* are used in their ordinary loose sense in this paragraph. More precise terms are used in Chapter XVIII.

It is important to keep in mind at all times that *the farm is the unit of productivity in agriculture and not the acre of land.* Area is important in that the more of it that must be included within any farm boundary, the longer the distance that must be traveled to and from the fields and to and from markets and schools, and the more fencing that will be required, although larger fields are likely to offset this latter in large part. But area is becoming less and less important with motorized equipment and improved methods of traveling.

But though lower-grade land may make a very good farm provided there is enough of it, its per-acre values must be in proportion to its net productivity per acre. In many sections of the country, in spite of the tendency of the better farmers to get on the more productive land, such land is relatively undervalued and the poor land overvalued. Apparently there is more competition for the cheaper than for the more expensive land because so large a fraction of our farmers have so little money with which to buy land.

USE OF SOIL SURVEYS Soil surveys can be of much use in selecting farms, but they must not be used in the simple naïve way of finding where the good land in an area is and then selecting a farm on that land. Instead, they should be used in selecting a combination of soils and topography that will make an adequate farming unit.[3] Every prospective buyer of a farm should see the soils he will have to work with, get an idea how much of each there is, see how they lie with respect to one another and to the farmstead; and if he is not already well acquainted with the yields he can expect from them under different cropping systems, he should find this out if at all possible. One way to become acquainted with the soil types is to get the county soil map, if one has been made, and mark out the boundaries of the farm on it. If the farm is not too small, the location, size, and shape of the areas in each soil type in the farm can be seen on this map. Table 82 shows the kind of descriptions of these soil types that are contained in the survey reports.[4] Some of the more recent of them give the estimates of average crop and pasture yields shown in this table. These estimates are based on the experience of many farmers with these soil types. They are averages which iron out the differences in yield due to differences in management skill. They therefore represent what an operator of average managerial ability may expect over a period of years.

[3] The following discussion and Table 82 were supplied by Carlton P. Barnes, Chief Analyst, Soil Uses and Productivity, U. S. Soil Survey.

[4] This table purposely shows two or three soil types common in each state so as to reveal the nature of the problem of selecting soils. Generally, one of the soils is much more productive, or responsive to management, than the others.

TABLE 82. INFORMATION CONCERNING SOIL TYPES FURNISHED BY RECENT SOIL SURVEYS, FOR A SAMPLE LIST OF SOIL TYPES FOUND IN NINE STATES [a]

Soil type and description — *Crop yields per acre*

HALL COUNTY, GEORGIA

Soil type and description	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B
Cecil sandy loam: 5 to 8 in. of grayish-yellow or light-brown friable sandy loam; underlain by red brittle clay; undulating; well-drained.	160	400	15	30	15	30
Davidson clay loam: 5 to 8 in. of brownish-red friable clay loam underlain by deep red heavy clay or silty clay; gently rolling; well-drained.	160	360	20	40	20	40

SUMTER COUNTY, ALABAMA

Soil type and description	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Soybean Hay Tons A	Soybean Hay Tons B
Norfolk fine sandy loam: 7 in. of gray fine sandy loam or loamy fine sand, underlain by 7 in. yellow fine sandy loam; this underlain by friable fine sandy clay; undulating; well-drained.	250	400	15	30	25	45	.75	1.5
Ochlockonee fine sandy loam: Brown friable fine sandy loam; well-drained; subject to overflow.	225	275	25	40	unsuited		1	2

JEFFERSON COUNTY, TENNESSEE

Soil type and description	Corn Bu. A	Corn Bu. B	Wheat Bu. A	Wheat Bu. B	Tobacco Lbs. A	Tobacco Lbs. B	Tim. & Clover Tons A	Tim. & Clover Tons B	Alfalfa Tons A	Alfalfa Tons B	Pasture Cow-acre-days A	Pasture Cow-acre-days B
Decatur silt loam: 10 to 16 in. of dark reddish-brown friable silt loam over 6 to 7 in. of dark red brittle silty clay subsoil; developed from limestone; undulating to gently sloping; well-drained.	40	50	22	30	1,500	1,800	1.8	2.0	4	4.4	90	130
Montevallo silt loam: 4 to 8 in. of gray or grayish-yellow friable silt loam over 4 to 10 in of silty clay, resting on shale bedrock; hilly; well-drained.	unsuited		unsuited		unsuited		unsuited		unsuited		20	30

Soil type and description	*Crop yields per acre*

PONTOTOC COUNTY, OKLAHOMA

Soil type and description	*Corn Bu.*	*Cotton Lbs.*	*Native Pasture Cow-acre-days*
Summit clay loam: 8 to 12 in. black or dark brown crumbly clay loam; 7 to 8 in. dark brown or yellowish-brown crumbly clay; 10 to 11 in. mottled clay; then olive-gray clay to limestone bedrock several feet below the surface; gently undulating, well-drained.	25	180	100
Denton stony clay loam: Dark brown, stony, shallow soil over limestone.	unsuited	unsuited	80

CATTARAUGUS COUNTY, NEW YORK

Soil type and description	*Silage Corn Tons*	*Oats Bu.*	*Red Clover Tons*	*Alfalfa Tons*	*Potatoes Bu.*	*Pasture Cow-acre-days*
Wooster silt loam: 24 in. of brown friable silt loam over glacial till; undulating to rolling; well-drained.	10	40	1.4	2.2	160	70
Volusia silt loam: Gray silt loam underlain at about 12 in. by impervious hardpan; gently to moderately sloping; poorly drained.	6	25	.6	unsuited	unsuited	40

LOGAN COUNTY, OHIO

Soil type and description	*Corn Bu.*	*Wheat Bu.*	*Oats Bu.*	*Clover Tons*	*Alfalfa Tons*
Brookston silty clay loam: Dark gray, friable silty clay loam overlying calcareous till at 36 to 40 in.; nearly level; artificially drained.	60	22	40	2	3.7
Miami silt loam: Gray-brown friable silt loam to about 10 in.; brown silty clay loam subsoil overlying calcareous till at 25 to 30 in.; undulating; well-drained.	45	25	35	1.8	3.3
Crosby silt loam: Brownish-gray heavy silt loam over dense impervious subsoil; nearly level, slowly drained.	30	15	25	1.2	2.0

DAVIS COUNTY, IOWA

Soil type and description	*Corn Bu.*	*Oats Bu.*	*Wheat Bu.*	*Clover and Timothy Tons*	*Alfalfa Tons*	*Pasture Cow-acre-days*
Grundy silt loam: Dark grayish-brown friable silt loam overlying clay at about 24 in.; gently sloping; internal drainage slow.	50	40	20	1.6	3.5	90

TABLE 82. INFORMATION CONCERNING SOIL TYPES—*continued*

Soil type and description	*Crop yields per acre*					
	Corn *Bu.*	*Oats* *Bu.*	*Wheat* *Bu.*	*Clover and Timothy* *Tons*	*Alfalfa* *Tons*	*Pasture* *Cow-acre-days*
Putnam silt loam: Grayish-brown friable surface soil overlying nearly impervious claypan at from 10 to 24 in.; nearly level; poorly drained.	25	22	10	1	1.2	35

BILLINGS COUNTY, NORTH DAKOTA

	Wheat *Bu.*		*Pasture* *Cow-acre-days*	
	A	B	A	B
Morton loam: 6 in. of dark grayish-brown loam, over 6 in. brown loam, then 6 in. light grayish-brown loam over subsoil containing lime carbonate; friable, well-drained; gently rolling.	9	15	20	33
McKenzie clay: 14 to 18 in. of nearly black hard clay overlying lighter-colored clay containing lime carbonate; nearly level; very slowly drained.	unsuited		7	12

BAKERSFIELD AREA, CALIFORNIA (*irrigated*)

	Cotton *Lbs.*	*Wheat and Barley* *Bu.*	*Fruit*
Merced clay loam: Dark gray friable surface soil; dark gray moderately compact subsoil; nearly level; slowly drained; small quantities of salts.	700	55	unsuited

	Deciduous Fruits	*Grapes*	*Cotton* *Lbs.*	*Alfalfa* *Tons*
Hesperia loamy fine sand: Light brown, very friable surface soil and subsoil; gently sloping; good drainage; salt free.	According to variety	According to variety	800 unfertilized	8 unfertilized
Fresno loam: Soil underlain by impenetrable hardpan at 20–40 in.; drainage poor; high salt content.		Unfit for crops.		Unsuited to reclamation

[a] Yields in Column A are those that may be expected, on the average, under the system of soil management most common or prevalent; those in Column B are those that could be expected if an improved system and practice of soil management were followed. Where only one column is given, the yields are those that might be expected from an average of all farms using the soil type.

The next step is to take the soil map out to the farm and examine on the ground the different soil types recognized and discuss them with the previous operator. To recognize some of the soils, it will be necessary to dig holes with a spade deep enough to see what lies beneath surface. The surface of a soil may give no clue, to an untrained observer, of the hardpan or gravel bed hidden beneath, or of the mottled subsoil that indicates retarded drainage.

The earlier soil maps were more general than those made during recent years, and do not show some of the smaller bodies of soils of a few acres that may be of importance in the operation of a farm. Still, such maps are highly useful. They may bring out important soil characteristics that would otherwise not be noticed by a prospective purchaser.

Many counties have no soil maps. The prospective buyer should then study a soil report for some other county in the same general area where the soils have been mapped. This should give him an idea of what to watch out for and enable him, especially with the assistance of the county agent, to make out a rough map of soil types on the farm in question. It may, for example, enable him to discover gray soils with a nearly impermeable layer beneath the surface which the survey showed to be prevalent in a near-by county.

There is a widespread belief that the way to find out whether a soil is good or poor is to send a sample of it to a laboratory and have it "tested." Such tests do indicate whether a soil is deficient in one or more important plant nutrients, or whether it needs lime for certain kinds of crops. But they do not tell us whether the soil is deep, has a hardpan, has good structure and texture, or good drainage, all of which affect the supply of moisture which the soil furnishes plants. These facts about soils have to be observed on the ground where the soil is. Most of the state agricultural experiment stations will analyze soil samples. Some require a small fee for the service. Before any samples are collected, however, specific instructions should be obtained from the state experiment station as to how to collect and ship them. Soil samples collected improperly can be not only useless but misleading.

BUILDINGS If a farmer were developing a new farm, it would be highly important for him to keep his investment in buildings in reasonable proportion to his investment in the land. The situation is somewhat different if he is buying a farm with buildings already on it. The important consideration then is whether the value of the farm includes a *building valuation proportional to what the buildings contribute to the farm income.* If the farm has too expensive buildings, this is of small consequence provided

these buildings are valued as if they were what the farm can afford now. The only extra costs that would be involved in these over-expensive buildings would be that repairs and upkeep might be larger than on the ordinary buildings. The depreciation will be no greater if the buildings are properly valued, since depreciation is in terms of value and not the physical properties of buildings. The buyer of a farm which is overbuilt is always in danger, however, of paying more for these buildings than they are worth from a productivity standpoint because there are always farmers who can afford to pay something for the prestige value of places that are somewhat on the showy order, or for the extra comforts and conveniences of expensive farm homes. Those who can afford this may find their money very well spent, but not the farmers who have large mortgages to redeem.

The next consideration is the condition and adequacy of the buildings. Although a farm operator with ability to repair and remodel his own buildings may be able to buy a farm with a run-down set of buildings at a more favorable price than a farm with good buildings, usually a well-improved farm is the better buy. At levels of construction costs that have prevailed since 1920, farms with inadequate buildings seldom sell for enough less to compensate for the costs of repair and enlargement. It commonly costs more to repair and remodel a set of buildings than is anticipated.

The convenience of buildings, and the layout of the farmstead in such a way as to keep the chore labor and the like at a minimum, may be much more important than some other aspects of the buildings.

The house on the farm needs to be considered from the standpoint of its desirability as a home on the same basis as if one were selecting a house in the city. Heating facilities, water supply, and electricity may be more important than the size of the rooms. Houses that have been built too large add greatly to the burdens of farm housekeeping.

RESIDENTIAL AND SOCIAL FACTORS Only three points will be mentioned in this connection. One is that some families can afford to pay for the home residential values of location on main highways and near to cities, and some cannot. The individual buyer needs to adjust his purchase to his available resources. The second is that location near to schools or school bus routes may be important because of time involved in getting the children to school. The third point is that residential location is important in resale value.

SIZE OF FARM The principles basic to a decision as to size of farms are developed in full in Chapter XIX. Only a few further points of

application need be made here. One of these has to do with the circumstance that farmers with small amounts saved are often disposed to buy small farms — if not small in acres, then small in productivity — so as to have farms of their own instead of operating longer as tenants on larger farms. If a farmer is getting on in years and sees no chance of saving enough to buy a full-sized economic farming unit, and wants to be sure of having a family home in his declining years, such a step has much in its favor. Occasionally even a younger farmer may advisedly choose to invest in a small farm, preferring to do his own work and live on what he can make on such a farm than to take on the responsibilities of keeping a full-sized economic unit going as a tenant. Many in the past have been so distraught over the perils of large mortgages that they have bought small farms so as to be free of mortgages even though their incomes are low. It should not need to be restated here that farming is more than earning a good money income. It is not the intent here to condemn such preferences, but a decision in favor of a small farm should be made in full awareness that the incomes will be low, and that probably more of the work will be done by hand and with horses. By continuing five more years as a tenant on a larger farm, a young man may be able to buy a farm that would yield him and his family a net income of $1,500 a year instead of half of this on a smaller or poorer farm. It may take longer to pay off a $1,000 mortgage on a 40-acre dairy farm than a $6,000 mortgage on a 160-acre dairy farm. The capacity of the farmer, however, is still the major determinant. The man who settles down on the 40 acres may well be only a 40-acre farmer.

The second point is to reiterate the warning against being misled by the number of acres in a farm. In a dairy-farming region, the safest guide to size is the number of cows which the farm will support; in a ranching region, the carrying power of the pastures and the winter feed supply; in a strictly cotton region, the number of bales of cotton which the farm will produce.

The third point is that smaller farms tend to be priced higher per acre than larger ones, even after allowance is made for the higher building cost per acre of the smaller farms. Competition is apparently stronger for small farms than for large ones. Under these circumstances, a purchasing farmer may well consider the alternative of buying more land and farming it somewhat less intensively.

Fourth, it should be pointed out again that farms often come in misfit sizes, not large enough for a hired man and too large for the farmer and his family labor, too large for one team of horses and not large enough for two, or under more modern conditions, too large to

be farmed with horse labor only and too small for one general-purpose tractor.

THE PRICE TO PAY The principles involved in a decision as to the price to pay for a farm were fully developed in the last chapter. These principles may be summarized and applied by saying that two approaches may be followed in determining the right price to pay for a farm. One is to compare the farm in question with prices at which other farms like it are being sold. This gives the market value of the farm. The other is to estimate and capitalize the expected net income. In some periods the results obtained by the two approaches may be widely different — either in periods while selling prices of land are strongly influenced by temporarily high farm prices and incomes, as during wars, or while they are under the opposite influence of severe depressions. The results obtained from capitalizing net incomes depend upon what net income figures are used. For example, the decision may be made to use the average net incomes for the period 1920–1940. This will probably produce land values that are too low, for it is doubtful if agriculture can be sustained on the basis of incomes of this order, since such incomes will not replace farm buildings and maintain the soil in the long run. The 1909–1914 basis used by the F C A will give values somewhat higher, but still not high enough. Net income may also be capitalized, as on many appraisal forms, in terms of yields of crops only, as if all the product of the farm were sold as cash crops in spite of the fact that all or more of the crops produced may go through a further manufacturing process and be converted into foods of animal origin. Computing net income in terms of crops only and of 1920–1940 prices, the South Dakota Experiment Station appraised the land in the western half of its state at 86 cents per acre in 1942; and the land in the eastern half of the state at values ranging from $12 to $50 per acre.[5]

A better procedure is to work out a plan of operation for the farm, as outlined in Chapter XXVIII, including the livestock operations as well as the crop operations, and to estimate the income from both, not in the past but according to what can be more reasonably expected in the future. After out-of-pocket expenses and a nominal allowance for the farmer's own labor and that of his family are deducted, the net income can be capitalized at the rate at which money can be obtained on mortgages in the area from reputable lending agencies, according to Formula I in Chapter XXXIII. Or one can instead estimate what the landlord's net income would be according to the prevailing share-lease

[5] Norris J. Anderson, *What Price for This Land?*, South Dakota Bull. 368, 1943.

system in the area and capitalize this in the same way. This will take a little less figuring and will give about the same results.

An alternative procedure is to deduct from the gross income, calculated as above, the necessary living expenses of the farm family and see what is left in the way of income that can be applied as payments on interest and principal of the mortgage. As stated in the last chapter, the result so obtained is not exactly an appraised value, but it comes close to being such, and is a guide as to whether or not a particular farmer can purchase the farm safely — after all, it is always a particular farmer who is buying the farm, or a particular landlord.

Neither of the results thus obtained may run as high as the current market value in periods of wartime prices. In general, a young man had better rent than buy at such periods. If, however, within five years after the war agricultural prices appear to have obtained relative stability and the prices seem higher than prevailed in 1935–1940, prices of farms may well run higher than those obtained by applying normal prices based on prewar conditions.

RENTING A FARM

There is need here only for mentioning a few factors in the situation in renting farms that differ from those in buying a farm. One of these is that the time span is shorter, since one does not in this country expect to spend the rest of one's life on a rented farm. Farm plans and incomes and receipts can therefore be worked out on a more definite basis. Usually it is best not to plan on renting more than one farm before buying. Special cases to the contrary are those in which the young man does not have enough working capital to start on a farm large enough to give full play to his abilities. He may therefore rent a small farm at the start, gain some necessary experience, and accumulate some savings, before taking on a full-sized farm. Some tenants may also want to break their stretch of years as tenants by shifting from share to cash renting as they accumulate the necessary working capital. It is usually desirable to rent in the area in which one expects to buy, at least in the last years of tenancy.

The next point of importance is that, as pointed out in Chapter XXX, farms in a given community usually rent at more or less customary rates. This is particularly true in share-rental arrangements. Competition in share renting takes the form of the better tenants and the landlords with the better farms getting together on the basis of the customary rental arrangements, and the poorer tenants and farms getting together

for the rest. Where these circumstances prevail, any tenant farmer should rent the most productive farm that he can handle.

In renting, the choosing of a landlord is as important as choosing a farm. A very little inspection of the premises will reveal whether the landlord is one who is careful about keeping up buildings and fences and maintaining the productivity of his farm, or is one who is anxious to get as much as he can out of the farm each year without much regard for long-run effects.

FURTHER READING

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*Hermon I. Miller, *Selecting a Farm in Vermont*, Vermont Circular 108, 1940.
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*Walter W. Wilcox and P. E. McNall, *Some Questions to Ask When Buying a Farm*, Wisconsin Circular 347, 1944.
**About That Farm You're Going to Buy*, U.S.D.A., Farm Credit Administration, Circular E–29, 1944.
*Lawrence A. Bradford, *Farming as a Business*, University of Kentucky Extension Division, Circular 401, 1944.
*Martin R. Cooper, *Getting Started in Farming*, U.S.D.A. Farmers' Bull. 1961, 1944.
*Franklin R. Zeven, *Matching Men and Farms*, U. S. Office of Education, Vocational Division Bull. 229, Occupational Information and Guidance Series 12, 1944.
**Shall We Move to the Country?* Illinois Circular 479, 1937.
*V. B. Hart, *Suggestions to Persons Who Plan to Farm or to Live in the Country*, Cornell Extension Bull. 652, 1944.
*Conrad H. Hammar and Diller C. Wood, *Safeguards in Financing the Purchase of a Farm*, Missouri Circular 451, 1942.

EXERCISES

1. The instructor should get the assistance of someone from the soils department and take his class out on some farm that has already been mapped, or that is mapped at the same time. The class should then assemble the necessary information to make a pre-estimate of yields, income, and debt-carrying capacity.
2. Describe the size and type of farm you would attempt to secure, its general location, and state whether you would rent or buy, under the following conditions: (1) You are 22 years old, with no experience as an independent farm operator, and have $2,000 cash; (2) You are 30 years old, married with two children not yet of school age, have farmed successfully as a tenant for 5 or more years, and have total assets of $6,000 to $8,000; (3) You are 42 years old, with three children in their early teens, have had several years of varied and successful farm experience, and have total assets of $14,000 to $18,000; (4) You are 55 years old and your children have left home.

CHAPTER XXXV

The Role of Public Agencies in Farm Management

THE PURPOSE OF THIS CHAPTER IS TO ANALYZE THE CONTRIBUTIONS which government agencies of various kinds now undertake to make to the management of farm businesses, and then show how farm operators can utilize these aids to best advantage. It does not undertake to analyze the contributions of government to agriculture in general; instead only those with respect to *farm management* as this is defined in Chapter I. The results of a vast amount of research in agricultural technology, and of education and regulation based upon it, are taken as largely given for the purposes of this chapter, just as they are for the specialist who sets out to analyze farm organization and operation.

Some may say, at first thought, that the title chosen for this chapter is a contradiction of terms, that farm management is private management by definition and that government therefore can have no part in actual farm management.

It is possible to conceive of a pure type of *private* farm management in which government agencies play no part whatever, other than to protect farm property against theft and willful destruction, assure the inviolability of contracts, and provide rural mail service and simple elementary rural education. This kind of pure private management largely prevailed in this country until around the beginning of the century. The intrusions of government before 1900 consisted only of tariff duties on many of the goods that farmers bought, and on wool, sugar, and a few other products sold by farmers; of some propaganda begun in 1859 to get farmers to grow, first, tea and then sugar beets and a few other products; of the introduction of a few new species of plants like alfalfa and durum wheat; and of legislation to regulate railway rates begun in 1887 with the passage of the first Interstate Commerce Act. In this period, no one in the public service undertook to suggest to farmers what they should produce, or even to supply them with information that might guide them in deciding what to produce. Neither did any public servant supply them with any information about prices, or

acreages of crops already planted, or the condition of the growing crops, or market receipts, or try to assist them in any way in deciding when to sell and at what price. If there were any market grades, they had been developed by the trade without any intrusion of government.

Under complete public management of farms, at the other extreme, a public authority would prescribe the amount of each commodity to be produced on each farm and designate to whom it would be sold and at what price. It would also set the prices of supplies and equipment and the wages of hired labor.

The actual farming of this and all other countries is obviously some combination of private and public management. The most extreme examples of private management actually found are modified by public regulations and by public services of one kind or another that existed scarcely at all in the last century. On the other hand, under the most extreme forms of public management which one finds in any country, the farm operator even in wartime has considerable scope for individual enterprise and decision. Our concern here is therefore not with one or the other of these extreme types of management, but with the combination of these that fits particular circumstances and situations. This combination obviously needs to vary greatly, depending upon circumstances of time and place. It will vary mostly as follows:

1. By periods — war versus peace, depression and emergency versus more normal times.
2. According to the condition of the individual farmer and his ability to plan for himself and to carry out his plans unaided. Differences in these respects may mark off whole groups of farmers.
3. By regions and areas. It follows from the two foregoing that particular regions or areas may be in difficulties and others not, and likewise large groups of farmers in particular regions. One needs in this connection only to think of the Dust Bowl in the 1930's.
4. By countries, because of differences in institutions and traditions and attitudes of the people, as well as in the condition of the people. One needs in this connection only to bring to mind the differences between such countries as the United States and China, and Puerto Rico and Denmark.

The reader needs also to be reminded at this point that the management which we are here considering is not only of production as such, but of marketing, financing, and the other phases of the function of management; also of leasing arrangements, wages, and working conditions, all of which are subject to much government control in some countries.

The approach to our subject that will be most helpful from this point on will be to consider separately the different forms of participation in management by government. They will be taken up in the following order: (1) those in which modern governments nearly everywhere engage in ordinary peacetime, about which judgments differ little except as to degree; (2) those which are provided for special groups of farmers in particular areas; and (3) those which are needed only in particular periods. At some point it will be necessary to consider briefly the participation in farm management by cooperatives. The discussion will be almost wholly in terms of institutions and conditions in the United States.

AGRICULTURAL EDUCATION

Let us begin with education, which all modern governments provide for farm people. Few persons raise any question as to the need for vocational agricultural education in the schools on all levels from primary to post-graduate. The questions posed are rather how much of the curriculum should be given over to such vocational education and how much kept for general subjects that fit a youth for other occupations or professions as well as for agriculture. Obviously, a large fraction of the young men born on our farms must look for their opportunities outside of agriculture. If all the farmers' sons born in the generation centering on 1940 were to remain in agriculture and become farm operators, around 175,000 new farms would be needed each year. A few of these youths, however, will be employed in services for agriculture, for which vocational agricultural training will be useful — such services as teaching, agricultural extension, managing of farm cooperatives, trading in farm products and farm supplies, and rural banking.

SCHOOL EDUCATION The reasonable procedure is to make some agricultural education available at all levels of school education, and let the pupils and parents choose how much of this to include, on the basis of the best information that can be made available to them as to the outlook for farming in the next fifty years. Some vocational training should be included even in the primary rural schools. This will be the last chance that many of them will have to get any agricultural education. The high schools in rural areas, however, will have the major responsibility for vocational agricultural teaching in the next several decades. They will train a large fraction of the future farmers of this country, and comparable schools will do the same in many other countries. This is about the level of education which the nation should plan for

the rank and file of the farm operators of the next generation. Agricultural education on this level therefore needs to be highly effective. It should provide a good foundation in the natural sciences, so that these farmers can read the bulletins and circulars presenting the results of the newest agricultural research; and courses in elementary economics and farm management pointed toward enabling farmers to read and use current economic information. The emphasis should be on how to apply principles and to use data, not on teaching rules of action. The farm management courses should include training and practice in making farm plans and preparing annual budgets. This should be the final stage in high-school training for the operation of farms. The other courses should provide the basic principles and materials needed in preparing such plans and budgets. Other courses should prepare young farmers to deal similarly with the marketing and finance problems.

Although vocational training on the high-school level is highly important, it should not be carried to the point of leaving little time for general courses in English composition, history, government, and the like, that all young people need as preparation for life and for their responsibilities as citizens.

More and more farmers of the future will be college graduates. The agricultural colleges can expect that more of their graduates will become farmers, and a smaller fraction of them become teachers, county agents, research workers, and the like. The colleges therefore need to provide a type of training that fits young men for actual farm operation. This means stronger emphasis on training for farm management as such. Agricultural college graduates should look forward to operating farms with gross incomes of $5,000 or more, and a large fraction of them, of $10,000 or more. At normal levels of prices for farm products in 1940, around 75,000 farms would have had gross incomes of $10,000 or more. Operators of farms of this size can derive great benefit from a properly balanced agricultural college education or its equivalent. Many of these farmers will inherit their farms, although perhaps under a mortgage written to pay off the other heirs. Those who do not should still make their plans with a view to developing at least a $5,000 business. Gross incomes of $5,000, and upward to $20,000 in many instances, will mean net incomes which, counting in the use of the house and the living obtained from the farm, are on a level with those of college graduates in other lines of activity.

Also, most farmers with college training will take part in the work of farm organizations or of cooperatives, or the local administration of the program of the Farm Credit Administration, the Farm Ownership

Program, and the Soil Conservation Service. Many of them will serve terms in state legislatures, and some even in Congress. They should therefore plan their education broadly enough so that they can measure up to such opportunities. This means that their training should not be too narrowly agricultural — as it has too often been in the past, because a large fraction of the students were expecting to become specialists in agricultural chemistry, genetics, plant pathology, soils, and the like.

The training in the high schools and agricultural colleges also needs to be integrated. Boys expecting to enter agricultural college later should take less agricultural training in high school than those who are expecting to begin farming at once. If they take agricultural training at both levels, they will leave college with altogether too narrow a preparation. Young men in agricultural colleges who are planning to be specialists of the above descriptions need at least a year of graduate work in any event. They therefore should not narrow their training too much in their undergraduate years.

The foregoing may seem to place too much emphasis on education in the schools. Many young men will farm as well without school education. With the right kind of agricultural college training, however, a young man's chances of becoming a successful farmer, or of playing an important role in activities off the farm, are much improved. That it should be of the right kind is exemplified by the following: Returning to his home community after many years' absence, a certain agricultural college professor inquired about two brothers who were his boyhood friends. Tom had gone to the state college and was now running the family farm. The younger brother Jim had not wanted to take time out to go to college before starting on a farm of his own. His parents helped him buy some cattle and farm machinery and he set himself up on a rented farm back on the crossroads. Ten years later Jim had bought a farm on the main road, and ten years later had burned his mortgage. Jim was also serving on the county board and helping to guide the fortunes of a local cooperative and a production credit association. There was no doubt in the community as to which brother was the better farmer. The difficulty with Tom, some of his neighbors said, was that he was still farming the way they had taught him to farm when he was at the state college twenty-five years before.

EXTENSION EDUCATION If all farm operators were agricultural graduates, would adult education, or extension, be needed? The answer is "yes." But it would be needed less than now, and its purposes would be different. It would be needed then because knowledge about farming

gets out-of-date pretty fast, both technical knowledge and the economic kind. Economic changes need to be studied constantly and analyzed, and even those who have graduated from college need to be kept informed as to the nature and meaning of these changes.

For those farmers who never get a high-school or college education *or its equivalent*, adult education is needed not only for the foregoing reasons but also to fill in the gaps in their basic knowledge and understanding of their farming problems. These gaps can be entirely filled if the young farmer has capacity for it and takes advantage of all the opportunities which can be afforded him by properly organized and oriented extension work. Helping such farmers to fill in these gaps is at present the responsibility of the agricultural extension service. It is, in fact, about half of the job of extension education. However, this type of education and helping farmers adapt themselves to change can be fitted together readily. The second can be used as a medium for the first. Educational method in this field would be greatly improved if much more of it took the form of teaching farmers to plan and budget their farms and to adapt these plans to changes in market demand, in numbers of livestock on farms, in weather and moisture conditions, and the like. Some of this needs to be individual instruction, but group farm planning can be highly effective if properly handled, as explained in a later section of this chapter.[1]

The county agents of the future need to be thought of as specialists. They ought to have at least one year of special training for their work at the start, and then more later. This does not mean that they should become Doctors of Philosophy. Instead, they need programs that include a strong emphasis on policy making, agricultural planning, public administration, and business. They should not get all this training at one time. Instead, they should interweave apprentice training as assistant county agents with advanced graduate training.

RESEARCH

The importance of research to farmers is not ordinarily recognized by them. They can scarcely read a page of an ordinary farm journal without coming upon several points of information of importance to them that are the direct results of research. They are so accustomed to using the results of research that they do not know that they are using them. While making a farm management survey, the writer one afternoon found the farmer sitting on his cultivator waiting for him at the

[1] See p. 787.

end of the row. The farmer was indignant when told the purpose of the visit, saying that the research they were doing over at the university was mostly a great waste of money. "What they ought to do was to take the professors over there and put them out on farms where they would learn what they ought to be teaching the boys in place of the nonsense they were giving them now."

The writer inquired about the variety of corn he was growing — it proved to be one that had been brought into the state and tested at the state experiment station. Did you have corn on this field last year? Yes. And the year before? No — he had come to the conclusion that it did not pay to grow corn on the same field too long. He had seen some figures in his farm paper several years ago that had started him to thinking. Whose figures were they? Well, he supposed somebody at some agricultural college had gotten them together. Just a slight smile this time. How many sows are you planning to have farrow this spring? Well, not so many. Only six. Hog prices are going to be lower next spring, they say. Who says so? Well, I have been reading about the hog-corn cycle and how corn is going to be higher priced than hogs for the next year or two. Who was it that figured out this stuff about the hog-corn cycle? This time a broad smile. The next question, and then all the rest of them, were from the survey blank which the writer had by this time spread out on his knee. The farmer had so many interesting things to say about his farm that were not called for on the survey schedule that it was two hours before the last question was answered, and time for supper all around.

In many parts of the United States the agriculture would be very different, and less important, except for the research that has been done. It was research that made possible the control of the boll weevil. Without spray programs developed by research, apples could not now be grown for market in the principal commercial areas. The research workers have not yet solved the problem of controlling "onion blast." It was research in genetics that gave us hybrid seed corn and blight-resistant potatoes and tomatoes. Research in genetics has increased the production of poultry flocks greatly in the last two decades. Research has developed the methods of soil management necessary for successful farming on many different types of soils. Every common practice on an ordinarily successful farm has been significantly modified by science in the past fifty years.

Individual farmers cannot do this research. If they did do it, there would be a vast amount of duplication.

Research is needed on various levels; in some cases, for all of agri-

culture and the whole of the country. Some of it is best conducted in the individual states where the results are most needed. Some of the problems needing solution are special problems of areas. This is particularly true of the farm management type of research. Much analysis of current change in economic factors is needed all of the time. This requires collecting data on prices, marketing, production, and the like.

REGULATION

Most persons like to see public regulations that are apparently in their interests imposed upon others, but are not enthusiastic about regulations imposed upon them for the apparent benefit of other groups. For example, the farmers feel the need of protection from commission merchants and railroads and like to see them regulated. The handlers of food products, in turn, like to see the producers of them required to deliver a disease-free product. Some of the regulation that has been developed is directly and immediately in the interests of agriculture as such. This is true of quarantine regulations that are designed honestly to prevent the spread of diseases and of controls to prevent bovine tuberculosis.

Other types of regulation appear on the surface to be in the interest only of consumers, such as the inspection of dairy barns and herds, of milk plants, of warehouses, and of meat-packing plants. But this is only on the surface. The consumption of milk has increased greatly as it has become a better product and largely free from disease germs. Consumers would eat pork much more sparingly if trichinosis were not under control. Nursery inspection is in the interest of those who buy from nurseries, and also of those who sell nursery products — if the Dutch elm disease is not controlled, nurseries cannot sell elms. If the activities of the commission merchants are not regulated, the farmers try to get along without using their services. A few in any line of business are in a position to spoil it for the rest. If the trade is allowed to regulate itself, it tends to become exclusive and monopolistic. The government is in a position to weed out the bad actors but let new firms get started.

Grading is a type of regulation that obviously benefits producers, handlers, and consumers alike. They all know more nearly what they are buying and selling when the product is properly classified and graded. It is much better to have one set of grades than two or three, and the government is in the best position to develop a set of grades that will be most generally acceptable. Grade inspection is a valuable supplement to establishing the grades, for it makes it possible for the parties to a deal to be sure that the product is correctly graded.

The methods employed are more in the nature of education than of policing. The principal effect of the regulations is to let people know the practices that are necessary to produce a safe product and to help them learn methods and form habits that will result in safe products. Penalizing a few of the producers may be necessary at the start in order to force producers and handlers to give the necessary attention to the problem; and watchfulness afterwards because new producers or handlers are always coming along who have not yet become educated. But penalties need to be imposed only on the few bad actors, who, like criminals, understand nothing except force and punishment.

INFORMATION

It would be hard to find a farmer who does not believe that public agencies should supply farmers with the information which they need in order to plan their farm businesses and do their buying and selling and borrowing most effectively. The most reserved statements that one encounters on the subject of participation of government in farm management run in terms of giving the farmers as full information as possible and then letting them make their own decisions. A few might prefer to have private market reporting services, trade papers, and the market pages of newspapers do more of the reporting and the government do less of it; but not many actual farmers. Therefore only the types of information to be furnished need to be discussed under this head.

PRODUCTION-PLANNING INFORMATION — EXTERNAL In order to plan his production, a farmer needs two general types of information which we shall here classify as internal and external. Let us first consider the information needed from outside the farms, such as information about market demand and prices, both in general and by individual products. This information needs to cover much more than the current situation. *It is prices and costs in the years to come that will determine incomes in the years to come.* Farmers must look outside their farms to see what is likely to happen in the years ahead to prices of various competing products, to wages, to prices of feed and fertilizer and other supplies, and to methods of production and the competition of other areas. Farm plans need in part to be made several years in advance. Not only must trends in prices be examined and interpreted, but also trends in production and consumption. Trends in foreign countries may need to be studied as much as trends at home. Obviously, most individual farmers are not in the position to do this unaided. The United States Department of Agriculture has gradually developed over the years, especially since

the last war, a program of collecting the information needed, analyzing it, and then disseminating it in forms that can be used either directly by farmers or by extension specialists, county agents, and others assisting farmers with their farm-planning problems.

The earliest information useful in farm planning collected in any magnitude by the Department of Agriculture was that on acreages, prospective yields and annual production of crops, and parallel information on livestock. This was published in the old monthly crop and livestock report. Later, data on prices received by farmers and wages of farm labor were added, and also an increasing amount of general information. This information was brought together annually in a statistical appendix to the *Agricultural Yearbook*.

Given such information, the farmer's only basis for projecting his acreage for the coming year was information as to acreage and yields and prices in the preceding year. In 1922, the further step was taken of asking the farmers in advance the acreages which they intended to plant of the different crops, and number of sows which they intended to breed, and getting this information out to the farmers before they did their planting and breeding, with the hope that they would modify their intentions and thus keep production better in line with supplies and market demand.

As a next step, the Department of Agriculture began preparing and distributing in 1924 an annual *Outlook* report. The first reports placed major emphasis on the general demand and supply situation for agricultural products. The later ones presented this information in more detail by individual commodities. The early reports limited themselves largely to presenting the data and facts, without trying to derive from them any statements as to prospects. Soon, however, they began to include forecasts of one kind or another, even as to the probable level of individual commodity prices, and a year or so later were going still further and indicating the shifts in production that would be advantageous in view of the prospective prices. The *Outlook* reports thus developed from simple *outlook* statements to *outlook and adjustment* statements.

By this time, the states and counties were also setting up state and county programs to achieve the production adjustments called for by the national outlook programs. State workers participated in national outlook conferences and most of the state extension services held conferences at which the national program was adapted to fit conditions in their states. County conferences were held at which state programs were further adapted to meet local conditions.

As a next step, the Department of Agriculture began issuing a few outlook statements in the course of the year in which emphasis was placed on prospective price changes in the months ahead. These forecasts in the yearly and intra-year outlook statements were, however, objected to strenuously when they apparently began to exert some influence upon the movement of prices, and Congress presently prohibited the publication of any statements concerning intentions to plant cotton, and the Department of Agriculture was forbidden to make any statements in the future tense in its 1932 *Outlook* report. The reports from this point on limited themselves to presenting facts and figures pointing out the trends and cyclical movements, and giving "interpretations" of the data. This obviously was a much *safer* procedure. The Department of Agriculture did not make itself responsible in any way for any decision which a farmer might make. It gave him the facts and let him make his own decision. However, it left the Department without any basis for recommending readjustments; and readjustments were very obviously called for when prices of farm products sank to very low levels during the Big Depression in the 1930's. The Federal Farm Board, which had been created in 1929, and had acquired large stocks of wheat and cotton, became very much interested in having the plantings of these reduced and made vigorous efforts to induce farmers to do so from 1931 through 1933.

With the passage of the Agricultural Adjustment Act in 1933, the nature of the outlook and adjustment program changed greatly. The quotas set up by the A A A, and the systems of benefit payments for producing within these quotas, and penalties for failing to do so, became new factors to take into account in farm planning. Responsibility for deciding what the national goals should be, and state and county quotas, were shifted to the A A A organization, which, however, had its local arm in every state and county. During the war, the quotas and systems of incentives were still more centralized.

The planners of these national programs, however, and also individual farmers planning their own production programs, have still needed all the information which they have been able to obtain on the external factors of demand, prices, and the like. The Department of Agriculture has therefore been free to develop its information services as such and incidentally to include a good deal of interpretation which in effect amounts to forecast. This information and interpretation is now published in an excellent series of *Situation Reports*. Some of these are general for all commodities and some deal with special commodities. The general information is issued in *Crops and Markets*, formerly issued monthly,

but only quarterly after the war began (price, 30 cents per year), *The Agricultural Situation*, issued monthly (50 cents per year); and a series of multigraphed releases called *The Demand and Price Situation*, *The Marketing and Transportation Situation*, *The Farm Income Situation*, *The National Food Situation* (all free), and a number of others carry specific information on the most important economic aspects of agriculture.

Crops and Markets consists almost entirely of tables of acreages and prospective yields, prices received by farmers, market receipts, stocks on hand, and related information. Acreages and yields are compared with those of the preceding year, and with the averages of the preceding ten years. Obviously, its issues contain a vast amount of data which is of little use to farmers in any one section of the country.

The monthly issues of *The Agricultural Situation* contain a very readable summary of general economic conditions and of conditions by individual commodities, and around a half-dozen short articles on timely subjects, such as, "More Protein Hays to Meet Feed Needs," "Concentrate Rations Fed Milk Cows," "1945 Farm Equipment Supplies," "Farm Labor; Problems and Programs." It contains regularly one table showing the index numbers of prices received by farmers by ten groups of farm products, index numbers of prices paid by farmers, wholesale prices and industrial production, and finally the parity ratios.

Those wishing more details on the general economic situation as it affects farm products will find these in *The Demand and Price Situation*, which carries regularly a table presenting general economic trends affecting agriculture, and several paragraphs on each of the major groups of farm products. *The Marketing and Transportation Situation* regularly carries tables showing the index numbers of changes in retail prices of foods, and of distributors' margins, for all food products combined, and by groups of farm products. These are carried for a considerable list of individual products. It also contains special articles on such subjects as readjustments in processing, the marketing of dehydrated fruits and vegetables, motor truck tonnage as related to the total tonnage of farm products, and the distribution of consumer's dollar spent for milk among the different agencies. *The Farm Income Situation* presents the monthly data on cash receipts from farm marketings, nationally and by states and regions, and sometimes breaks these data down by commodities.

The National Food Situation, begun when the war started, undertakes to report total current food supplies as compared with 1935–1939 and the immediately preceding years, and to break these data down by commodities and groups of commodities, and according to uses.

Farmers interested in particular products or groups of products will find very useful the *Situation* reports by commodities, including cotton, poultry and eggs, dairy products, livestock and wool, fats and oils, all published monthly; those on tobacco, vegetables, and fruits, published only quarterly; and the one on wheat issued bimonthly (all these are free). All livestock producers will find highly useful the report on feed which summarizes the data on production, stocks, and prices of the different feed grains and by-product feeds. Individual issues make special analyses of such subjects as the oilseed meals, the protein feeds, and the relation between prices received by farmers for meat animals and for feed grains and hay.

These *Situation* reports can be read and understood by anyone accustomed to reading the daily newspapers, but of course they are not as readable, since the information in them is closely packed and reinforced by tables and charts.

A majority of the states now publish current analyses of economic change and prices and other data relating to products in their states. They also frequently contain analyses of problems of current interest to farmers. On the whole, they are more readable than the reports issued by federal agencies and, of course, better adapted to situations within each state.[2] The state agricultural statisticians also commonly issue short mimeographed releases giving monthly data concerning crops, prospective yields, and other local information.

The commodity situation reports present in season the results of the intentions-to-plant and intentions-to-breed surveys. Two such reports are made for hogs. The cotton report contains no intentions information, since Congress has made it a penal offense for any federal servant, including the county agents, to make any statements on this subject. Superficially, it would appear that the cotton growers prefer to be kept in the dark as to what their fellow cotton growers are planning to do.

Information on farm supplies is less generally available than that on farm products. It is limited to *The Feed Situation* for the most part. The information on prices paid by farmers is only in the form of a national average index figure, except that a few states are now publishing index numbers of prices paid, and data on feed prices and the like.

PRODUCTION-PLANNING INFORMATION — INTERNAL Even more essential for farm planning and budget making than the market price and other current situation data contained in the foregoing reports are

[2] The names of several of these are: *Farm Economics* (Cornell), *Farm Economic Facts* (Mass.), *The Farm Economist* (Iowa), *Farm Business Notes* (Minn), and *Illinois Farm Economics*.

data on inputs of feed, fertilizers, and other supplies, and on man labor, horse labor and equipment, and all the related types of data needed to put together a well-balanced farm organization, and to replan this organization from year to year. As made clear in earlier chapters, these input and output data vary according to cropping systems, soil types, and other factors. Neither the inputs, nor the input-output relationships, are constants from area to area, or farm to farm. Neither are they constants in the sense that they remain the same from year to year. The individual farmer, therefore, must always adapt to the special conditions on his farm any input or cost data that may be supplied him by his state experiment station. In order to do this well, he needs the kind of records for his farm that are discussed in Chapter XXIII.

Also as explained in Chapter XXIII, information of this sort is compiled in two ways: (1) by trials or tests at experiment stations, and (2) by surveys which summarize experience under actual farming conditions. Although large sums have been spent in the last fifty years in running such tests or trials, and on surveys, the available data fall far short of what are needed. One reason for this is that much of the testing and many of the surveys have not been conducted in such a way as to provide the kinds of data needed. The federal government has done relatively little along these lines. An Office of Farm Management was set up soon after 1900 and incorporated in the Bureau of Agricultural Economics in 1922. But it has always had a very small personnel. The federal organization for furnishing marketing information and services was employing over a thousand workers by 1920, and the Division of Farm Management and Costs less than fifty. The state governments have commonly set up divisions of markets, but few services having to do with production organization. The agricultural extension workers are organized in such a way that they could disseminate farm management information very effectively if it were made available to them in sufficient quantity and if they knew how to use it effectively.

It should be obvious that such data need to be kept up-to-date and supplied currently — fully as much so as data on acreages and production. Thus, if a farmer is to keep his production methods abreast of the times, he needs data with respect to the new types of power, tillage, harvesting, and other equipment which are constantly being made available, as to the duty of these machines, the quality of the work they do, and their depreciation rates and repair costs. He needs similar information as to new species of plants that are being introduced and new varieties. Suggested innovations in cultural practices should be tested and reported upon promptly. They should have known already

Information on farm credit is now furnished in occasional articles in *The Agricultural Situation* and in *The Agricultural Finance Review* published annually since 1938.

AIDS FOR SPECIAL GROUPS OF FARMERS

A large fraction of the farmers in most sections are not in a position to apply the foregoing kinds of information without some further help. It may be only a little help or a good deal. Some will argue that they should nevertheless be left to their own resources. The prevailing view is that the nation needs also to have the agriculture of these less favored groups improved. The problems then are how far to go in helping them, and in what form to furnish this help.

One procedure is to classify their farms into types and subtypes and make analyses of each of these to determine the particular adjustments commonly needed on the farms of this type or subtype. Such analyses might arrive at the conclusion that the dairy farms on Gloucester loam soils in a certain section of a state or county need to have their pastures and hayfields improved so as to reduce the feed bills and increase the number of cows that can be kept; and that the best way to do this improving is to follow a certain program of liming and fertilizing, to seed ladino clover on a fraction of the pasture each year, and to restock the hayfields by plowing them every five to seven years, using oats as a nurse crop, and including alfalfa in the grass-seed mixture. The recommendation for adjoining type-of-farming areas differing from this by having more tillable land might be to combine with the foregoing a second rotation system that includes corn silage for a year before the reseeding. These recommendations can be presented in such a way as to provide for variations by individual farms according to the available labor force, the capital resources of the farmer, and the particular combination of land types on the farm. In the main, however, the individual farmers must be responsible for making these adaptations. The adjustments recommended are for the most part of a long-run nature. But the short-run adjustments needed in any area can be determined and recommended in the same way as the long-run ones.

This method of aiding the rank and file of farmers received a great deal of attention in the late 1920's. It was responsible for the making of the type-of-farming survey in connection with the 1930 census. Its further adoption was interrupted by the agricultural depression beginning in 1930, by the production controls provided in the Agricultural Adjustment Act of 1933, and later by the wartime goal programs.

Another procedure is to develop a set of standard farm organizations or setups that will pretty well cover all the major situations in a section or part of a state, describe these in detail as to cropping system, livestock, and equipment, and present full-length budgets for them. The individual farmer then chooses the particular standard form which meets his conditions most nearly and fits his farm organization as closely to it as he can. In a majority of cases, some important adaptations are needed. The changes needed in the short run for these standard farm setups can also be determined by the extension service and disseminated among the farmers. Such a set of standard farm organizations for an area in North Carolina might include those for one-mule cotton farms, two-mule cotton farms, 40-acre family-size tobacco farms, two-mule cotton-and-tobacco farms, and so forth. This is the approach to the problem which is emphasized by Professor G. W. Forster of North Carolina State College.[4]

A third procedure is to undertake to help each farmer in the actual preparation of a plan and operating statement for his farm. Time is saved if the farmers are brought together in groups and assisted in working up their plans together. The extension economist begins these group meetings by working through one such plan before the group. The farmers bring the data and maps for their farms to the second meeting and proceed to set up budgets for various alternative plans and programs. This procedure can take the place of the first two entirely, or it can supplement the first for those farmers who are not able to choose the farm organization which is best suited to their conditions and help them make the needed adaptations. This kind of help in planning should not need to be furnished indefinitely. Once a farmer has a basic farm setup established, he can make later adjustments himself with very little help. It may, however, take two or three years to get the plan just the way the farmer wants it. Many of the farmers will need credit in carrying out farm plans thus developed. Planning and credit thus become tied together into a very effective instrument for improving farm organization.

EMERGENCY PERIODS

During critical periods in the nation's history, such as during wars and subsequent reconversions, or during severe depressions such as in the 1930's, or following disasters such as caused by the boll weevil in the South in the 1920's, or by drouth in the Great Plains in the 1930's,

[4] See Chapters 9 and 10 of Forster, *Farm Organization and Management.*

the procedures outlined above are likely to be too slow. In wartime, the nation may need a large increase in its acreages of oil crops, or of dry peas and beans, or a rapid increase in the number of hogs or dairy cattle. Following the war, there may be equal need for a shift away from these products. As pointed out in Chapter XX, farmers tend to maintain production at high levels during depressions; also to expand their production when prices are high and not to reduce it afterwards.

There are a few who contend that it is best even under such circumstances to let the forces of supply and demand determine the adjustments. They favor letting the shortages of farm products that develop in wartime produce sharp increases in prices, which in turn produce sharp increases in output. The difficulty with this program is that the prices do not rise soon enough, and then rise altogether too high, and in consequence the production increases lag and then overreach themselves, and are followed by severe price declines. These extreme fluctuations are very wasteful of resources. Consequently, most persons favor the use of positive measures, such as the following:

1. Increasing greatly the attention given to helping farmers with their planning. This requires determining the adjustments that are called for in the emergency, disseminating these results among farmers, and then working with individual farmers who need help, or with groups of them.
2. Making credit more freely available to help farmers hasten their adjustments.
3. Price supports. A mere guarantee of a price without any increase in it usually produces a considerable expansion of production. If this does not promise to induce enough increase, the support price can be increased above its former level. It is important not to furnish any support for products whose output should be decreased to make way for those that need to be increased.
4. Subsidies to producers. These may take the form of furnishing needed supplies below costs, as was done with feed during the war. The most effective type of subsidy is one which is applied only to increased production, like extra pay for overtime. This was used by the War Production Board, but was opposed for farm products by Congress and by the farmers because of the way in which it was presented to them.

When contraction of output is needed instead of expansion, these same methods can be applied more or less in reverse. Support prices may need to be applied to the products that should take the place of those that have been overexpanded during wartime.

PARTICIPATION IN MANAGEMENT BY COOPERATIVES

A possible alternative to having public agencies work with farmers on their farm management problems is to have cooperatives provide these services for their members. In general, the more of such services that cooperatives will supply, the less that public agencies will need to concern themselves with them. Cooperatives have not used their opportunities along these lines to any considerable extent. The most valuable efforts have had to do with improving and standardizing the quality of their products, with introducing orderliness into the production programs of their members, and with adopting more orderly procedures for marketing. The efforts along the latter of these two lines, however, have been fraught with some dangers, for a few of the cooperatives have been disposed to enter into contracts with their members to restrict output, and more of them, as pointed out in Chapter XXXI, to hold their product off the market as a way of enhancing its price. The Capper-Volstead Act passed in 1922 permits cooperatives to enter into agreements with their members as long as the results do not increase prices unduly.

The cooperatives can be of most service to their members along these lines if they will join forces with the agricultural extension service in helping with the farm planning and adjustments. They can also contribute importantly to decisions as to the general direction which production adjustments need to take because of their close contact with markets.

SPECIAL TYPES OF AGENCIES The foregoing classification does not include a number of types of local units which are more or less cooperative in nature, but which operate under the governmental sanction and protection. An early form of these is the drainage district under which landholders in an area are permitted to organize and issue bonds that are thenceforth handled much like public debt. Congress later permitted homesteaders on swamplands to organize in this way and get their lands drained before they moved onto them — this was highly necessary in the case of lands more or less under water, as in the rice areas of Louisiana and the peat marshes of Minnesota. Irrigation districts were organized in much the same way. The most recent developments of this sort relating to land are the soil conservation districts provided for in most of the states, the grazing districts set up under the Taylor Grazing Act, and the grazing associations of the northern Great Plains states, both discussed in Chapter XLIV. In the field of marketing, the best

examples of this type of agency are the milk administrations set up in a score or more of the larger milksheds.

The importance of such agencies is that they permit a combination of private and public action such as is frequently needed to attain important ends. A group of landowners without public sanction could not do many of the things done by these agencies. A purely governmental agency could not secure the kind of participation from individual landholders that is needed.

EXERCISES

1. Considering the number of young people in your home community in relation to the opportunities for good livelihood in that community, how well do you think the educational facilities available fit them for earning a living?
2. Describe five types of governmental — state or local, as well as federal — regulation that affect farm production practices or marketing of farm products in your home community.
3. Do you think that farmers in your home community plan their production and marketing plans for the months of the year ahead primarily on the basis of anticipated conditions at that time, or primarily on the basis of conditions of the recent past? How adequate do you consider the information available to them for their production and marketing planning? If you consider it inadequate, how would you suggest it be improved?

Part Five

MANAGEMENT BY TYPES OF FARMING

CHAPTER XXXVI

Wheat Farming

THE GROWING OF WHEAT HAS ALREADY BEEN DISCUSSED IN THREE chapters of this book: first, in Chapter VIII in terms of one-crop wheat farming in the Pacific Northwest;[1] secondly, briefly in Chapter X in terms of the wheat-cotton combination in western Texas;[2] and third, in Chapter XIV in terms of the grain-livestock combinations of the Great Plains.[3] Certain of the management problems of wheat farming in these chapters need to be explored further; and some additional ones need to be introduced.

THE TOTAL SITUATION[4]

Let us first look at the wheat situation as a whole. Chart 107 presents a map of the United States by wheat-growing regions with the distribution of acreage in 1939, and Chart 108 the acreage changes by regions from 1910 to 1945. The peak year in acreage harvested was 1919 with 77.4 million acres. Data on seeded acreage are available only since 1920. Seedings reached their peak at 81 million acres in 1937. A strong decline in wheat acreage set in when prices of wheat subsided late in 1920. Some of the land broken to grow wheat during the First World War was allowed to lapse temporarily into range again. Then mechanization began producing its effects and an expansion began in 1924 which was really checked only by acreage control in 1938 which set an upper limit of 53 million acres. Vast stretches of range in the western Great Plains were converted to wheat. Severe drouths caused the abandonment of large acreages of this in 1931 and 1933 to 1936. Over half the spring-wheat crops of 1934 and of 1936 were never harvested, and 45 per cent of the hard winter-wheat acreage seeded in 1933 and in 1935. In spite of the extremely low prices of 1930 to 1934 — farm prices for wheat

[1] See p. 176 ff. [2] See p. 221 ff. [3] See p. 322 ff.

[4] This discussion draws freely upon *Wheat Production in War and Peace*, Carl P. Heisig, Ernest R. Ahrendes, and Della E. Merrick, U.S.D.A., 1945.

dropped from $1.04 in 1929 to 39 cents in 1931 — the seeded acreage was 1.5 million larger in 1930–1934 than in 1925–1929. The crop control measures of 1933–1937 did not curb wheat plantings appreciably.

It is notable that the wheat acreage did not increase during the Second World War until 1944. The government continued its controls until the fall of 1943, and besides was supporting high prices for flaxseed, dry beans and peas, and soybeans. The stocks of wheat at the out-

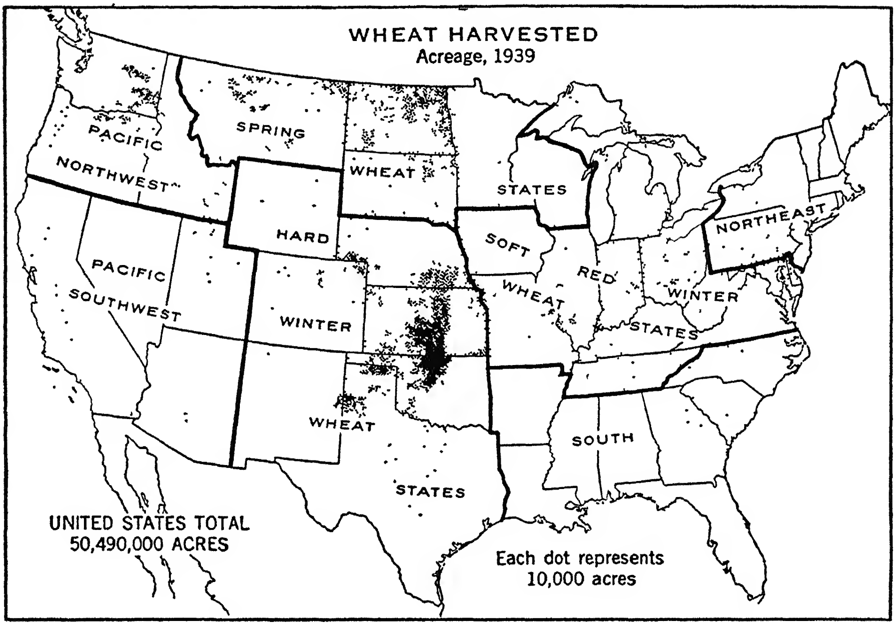

CHART 107. Wheat regions and distribution of wheat acreage, 1939. (Figure 1 from *Wheat Production in War and Peace, op. cit.*)

set of the war, and the high yields from 1941 on, provided ample supplies even though 500 million bushels were used as livestock feed in one year.

The trends in wheat seedings since 1920 as distinguished from harvestings are worth noting by regions. Most of the increase from 1924 to 1937 was in the hard red winter-wheat states. The spring-wheat acreage rose about 3 million acres from 1924 to 1928 and then remained close around 20 million acres until 1938. The harvested acreage, shown in Chart 108, was trending downward from 1929. The general trend in the North Pacific wheat states was mildly upward until 1933 and downward afterwards. It is obvious that other influences were operating in this region. Seedings and harvestings followed similar patterns in the soft red winter-wheat region. Crop control seems to have induced

expansion rather than contraction in that region from 1933 to 1937. The acreage of wheat is small in the South, but has been increasing since 1930. The Pacific Southwest also showed some increase from 1924 to 1937.

If allowance is made for the adverse weather, the average yields of wheat increased in this country from 1910 to 1944. Postwar yields in

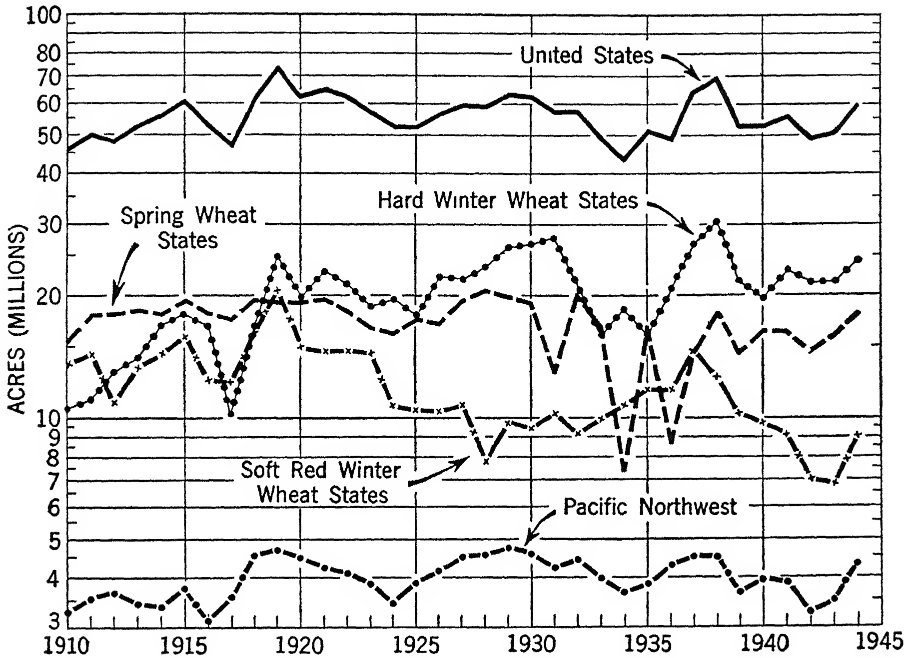

CHART 108. Acreage of wheat harvested by major wheat regions, 1910–1945. (Figure 2 from *Wheat Production in War and Peace, op. cit.*)

normal years are expected to average 14.4 bushels compared with 12.5 in 1910–1944. This increase has taken place in spite of the shifting of wheat production to drier territory because of improvements in varieties, in disease control, in moisture conservation, and in erosion control. Without production control, and with price supports at 90 per cent of "parity" figured on the 1910–1914 base, the acreage of wheat is likely to run as high as 65 million and production as high as 950 million bushels, which is 100 million bushels more than will be consumed in this country or exported unless special measures are taken to dispose of surpluses. Certain over-all and regional adjustments in wheat production therefore need to be considered. These should not involve subsidies continuing indefinitely.

PRODUCTION ADJUSTMENTS

The most obvious type of production adjustment is to shift to other lines of production. It has already been pointed out that this is difficult for wheat in the United States because its production is already confined largely to areas which have no alternative except ranching, which yields only a small return per acre. But still there are large border areas where shifts are possible. The most important of these are in the eastern edge of the wheat-growing region. Consider Nebraska and Kansas as an example. Chart 109 presents a ten-year moving average of the rainfall of Nebraska divided into eastern, central, and western. The rainfall pattern of Kansas looks much like this. Budget analysis of grain-livestock farms in Chapter XIV showed rather wide ranges of possible combinations in the eastern and central divisions of these states. If the price of wheat is allowed to sink to a competitive level, a large fraction of the farms in these divisions will make larger returns if they shift part of their wheat acreage to alfalfa, sweet clover and other hays, or to soybeans, barley, and other forage and feed crops, and keep more beef or dairy cattle, hogs, or sheep. The Palouse part of the North Pacific region will move faster than now in the same direction. Grain-livestock farms generally will move slowly toward keeping a little more of their rolling wheatlands in range. Shifts in the direction of more range livestock and less wheat are aided by range-improvement measures to be outlined in Chapter XLIV. If the prices of beef and pork hold up better than the price of wheat, corn will also replace wheat in some areas. Also, less soft winter wheat will be grown in the Midwest; and farther west, these farms may find that growing wheat and feeding it to livestock is the most productive use of their land.

A positive readjustment program as distinguished from the full-support program would take the form of direct payments, or subsidized loans, or both, to help farmers make shifts of the sort outlined. The effect of these would be to weight farm budgets in favor of production plans with less wheat in them, or at least, less wheat sold for cash.

Size of enterprise may also be a factor in these adjustments. First of all, as more acreage is included within a farm, more of the land can be used as pasture and still leave enough cropland for an adequate farm income. Even more important, a wheat farmer needs a higher price in order to make an adequate income if he has a small acreage than if he has a fairly large one. One reason for this is that equipment costs are lower per bushel when the equipment is more fully utilized. The farmer's own labor is also more fully employed. But part of the explanation is

the simple result of profit per unit of output times volume of output. Heisig, Ahrendes, and Merrick have compared three farm organizations for spring-wheat farms in northwestern North Dakota or northeastern Montana: one of 400 acres practicing a wheat–wheat–fallow rotation: one of 600 acres following the same rotation; and one of 800 acres practicing the wheat–fallow rotation.[5] To give this farmer a 4-per cent return on his investment and $1,000 of income for his family, assuming normal yields for this area, and cost-rates at 1944 levels, would require

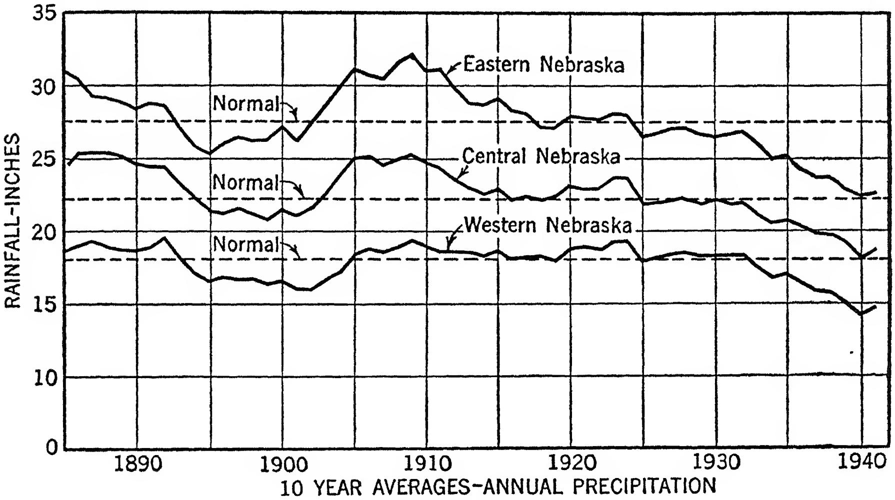

CHART 109. Ten-year moving averages of precipitation in eastern, central, and western Nebraska, 1876 to 1942. (Figure 1 in *Summer Fallow in Nebraska*, Nebraska Bull. 363, L. L. Zook and H. E. Weakley, 1944.)

$1.09 a bushel for wheat with the first organization, 86 cents with the second, and only 78 cents with the third.[6] Or stated another way, 80 cents a bushel for wheat would yield a labor-and-management income of $1,100 on 800 acres of this land if it were operated as an 800-acre farm with the wheat-fallow rotation, and two labor-and-management incomes of only $340 if the 800 acres were split into two farms of 400 acres, each operated according to the wheat–wheat–fallow system. The 800-acre farm would still be a family-size farm — it would hire only thirty days of labor. There would be fewer farm families in the wheat regions if the farms were enlarged in this way, but the total net farm income of the wheat regions would be increased by a half. The typical family-

[5] *Ibid.*, p. 37.

[6] Yields of 12 bushels assumed with the wheat–wheat–fallow rotation, and 14 bushels with the other.

operated wheat farm in the hard winter-wheat regions in 1910–1914 was 330 acres with 180 acres in wheat; by 1938–1942, it had expanded to 620 acres with 350 acres of wheat. But enough farms were smaller than this to bring down the 1940 average to 530 acres.

So far as mechanization goes, from 70 to 95 per cent of the wheat farms in the West were using combines in 1936, and about an equal proportion were using tractors. Fuller use of such equipment and better adaptation of type of equipment to the size of the farm and type of tillage needed, are the main opportunities for progress in this line. Also Diesel tractors may be used more in some areas and lead to still larger units. Between 1909 and 1936, the hours of labor per acre of wheat were reduced from 6.1 to 2.2 in the western part of the hard winter-wheat area, and from 8.1 to 3.6 in the eastern part of it; from 6.4 to 4.9 in the eastern part of the spring-wheat area; and from 7.2 to 3.4 in the Pacific Northwest.[7]

BETTER ADAPTATION OF WHEAT GROWING TO RAINFALL

The relatively low yields of wheat, it should now be clear, are not in themselves serious obstacles to needed adjustments in western wheat farming. Modern power and equipment have reduced the labor of the preparation of the land and harvesting to such a level that yields as low as 8 bushels per acre or possibly less would still permit reasonable incomes on farms of adequate size — if the 8-bushel yield were fairly dependable. The planting of crops that are never harvested adds importantly to the cost; but more serious is the fact that the farm family has nothing to live upon in the years of crop failure, and poor crops may follow one another for several years. Chart 109 shows this very clearly all the way across Nebraska — low precipitation for a long stretch in the 1890's, then exceptionally good rainfall for another decade, then about normal from 1910 to 1925, then a very bad ten years. Chart 110 shows the annual deviations for North Dakota and New Mexico. North Dakota has shown a marked tendency for wet years to occur in sequence, and dry ones also. During an 18-year period, beginning in 1899, precipitation was above average in 15 of the years. Before 1900, it had more or less alternated above-and-below the average. To some extent, the same thing was true from 1917 to 1928, although even here the years tended

[7] Robert B. Elwood, Lloyd E. Arnold, D. Clarence Schmutz, and Eugene G. McKibben, *Wheat and Oats*, Works Progress Administration, National Research Project, Report A-10. April, 1939.

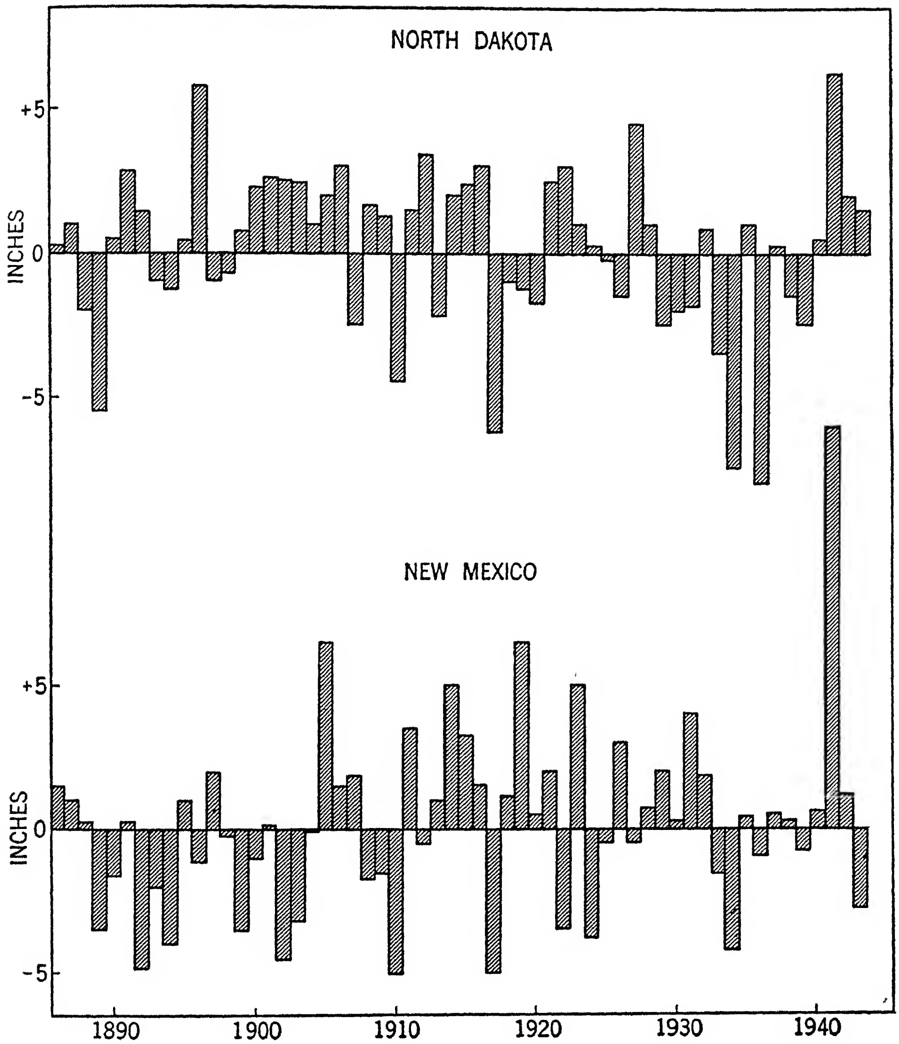

CHART 110. Annual deviations from average annual precipitation, 1886–1943, North Dakota and New Mexico.

to bunch in groups of 3 or 4. Then in 1929 began a period of 11 years in which precipitation was below average 8 of the years, and even in the other 3 years was only slightly above average. Since 1940, each year has had precipitation above average.[8] While it is conceivable that this sequence could occur by pure chance, a much more likely explanation is that some factor was operating which tended to cause

[8] J. E. Pallesen and H. H. Laude, *Seasonal Distribution of Rainfall in Relation to Yield of Winter Wheat*, U.S.D.A., Washington, D. C., Technical Bull. 761, 1941.

periods of wet and dry years. In contrast, New Mexico has had much more nearly a year-to-year alternation of wet and dry years. In only one instance do 5 successive years fall on the same side of the average, and in general, excessive precipitation in one period has been offset within a very few years by equal deficits.

When all the Western states are analyzed from this point of view, a rather consistent tendency appears for wet and dry years each to occur in groups in all the northern part of this area, a low tendency in this direction in the Southern states, and an intermediate pattern in the intervening states, as indicated by Chart 111. These are only tendencies, however, and based on too few weather stations and too short a record to make the precise location of the lines dependable. Furthermore, one cannot be at all sure that the next forty years will be like the last forty in this respect.

Historically, these sequences in the northern Great Plains have had very profound effects. The period of 1900–1916 was one of rapid western extension of the frontier of crop growing. The settlers in this period formed an entirely erroneous idea of the potentialities of their land, and based farm size, family living standards, and local government on this misconception. We may think we know better now, but another series of wet years might start us on another line of thinking. Likewise, of course, the conditions of the 1930's led to much unwarranted pessimism as to the long-term future of the Great Plains. One program of adjustment to these conditions is to have the scientists decide what is the long-term average precipitation to be expected in any area, and to map out a land-use and cropping program adapted to this. If this average is too low for wheat, let the area be set aside for range — purchased by governments if nothing else will suffice, and converted into public range. If the rainfall of an area is enough for wheat, let its land be classified according to the fallow system it will support to best advantage over the years, and let these classifications be known to everybody.

A more difficult program for land suitable for wheat, but a better one if it can be effectuated, is to have a flexible fallow system that will shift from a wheat-fallow rotation to wheat–wheat–fallow when the ground moisture is adequate in the spring and in a period of accumulating surpluses of rainfall. The scientists could furnish considerable guidance for such a program if they were willing to take some chances.

Another major type of adjustment is to conserve moisture more effectively. Two inches of rainfall above or below the critical level will make the difference between crop failure and a good wheat crop on much of the Great Plains. In Chapter XXVII we pointed out how small a frac-

tion of the rainfall actually gets a chance to be used by growing crops. Improving the technique of moisture conservation and use could therefore easily raise many areas above the critical level. Confining wheat to the gentler slopes with slower runoff also helps greatly.

When, however, a bad year strikes, or especially a series of them, the wheat growers may be hard-pressed to provide for their families. Theoretically, if they were following any of the programs outlined, and were growing wheat only where wheat is above the critical level, they

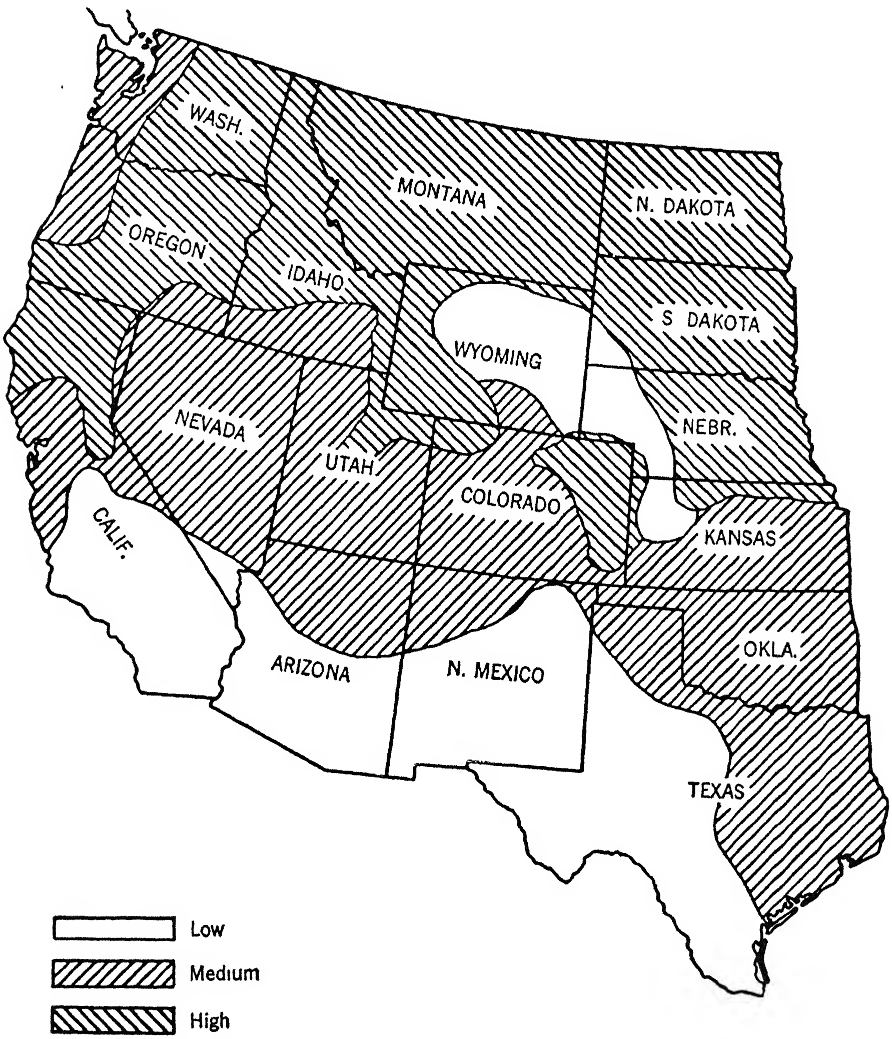

CHART III. Zones of equal tendency for dry and wet years to run in sequence, 1900–1939.

should build up enough reserves in years above the average to carry them in other years. But most human behavior is not that rational. After several years of outright relief payments to wheat farmers in the 1930's, or relief disguised as loans, the federal government authorized the systems of wheat crop insurance referred to in Chapter XXXIII. Farmers were given their choice of insuring 75 per cent or 50 per cent of average yield, the premiums naturally being higher for the higher coverage. The premiums were based partly upon the individual's yield record and partly upon yields in the county, and were payable in wheat (or if in money, the amount was calculated according to the current price of wheat). Payments were also made in wheat, or in cash calculated on the basis of current wheat prices. The insurance was thus only for the amount of production, not for income. The administrative costs of this program were borne by the federal government, on the grounds that relief expenditures, previously borne by the government, would be reduced thereby. As indicated earlier, this program encountered difficulties, with the payments for crop losses consistently exceeding the premiums collected. But it is being continued and even extended to other crops. Such insurance should not, of course, be subsidized beyond the initial stages. Wheat growing in the great West needs to stand on its own feet.

EROSION CONTROL

Soil blowing is so peculiarly a problem connected with wheat growing in this country that the discussion of it in Chapter XXVII needs to be elaborated somewhat in this chapter. Fallowing, of course, leaves the land bare for several months. Formerly it was considered desirable to make a "dust mulch" on top of the soil, to break the capillary movement of water from lower levels. The dust-mulch idea has been largely abandoned, but the land is still cultivated to control weeds. This accentuates soil blowing. In some areas, the stubble is burned. This promotes soil blowing by lowering the organic matter in the soil and hence retarding water absorption. It is still widely practiced because it may increase crop yields in the immediately following year; the straw in the soil takes moisture and nitrogen away from the wheat. The approved practice at present is to plow the straw only partly under, leaving the ends sticking up in the air to impede the soil movement.

There is little to add on the subject of strip-cropping. The general width of the strips is adjusted to the wind hazard; the exact width can be adjusted to size of machinery. In some areas, the strips are at right

angles to the prevailing winds; in others, on the contour to aid in moisture conservation. In areas of severe blowing, permanent buffer strips may be planted; this is more common in the southern Plains where cotton is grown without fallowing than in the wheat areas.

Tillage methods which leave the surface rough impede wind movement and also promote water penetration. The duckfoot cultivator and similar tools are used in some areas, rather than the disk or disk plow, because they tend to leave the surface rougher. The basin lister is used in many areas; it builds a furrow and puts small dams in it at intervals, so that the field becomes a series of small ponds, perhaps 1 foot wide and 3 to 6 feet long, after each rain. The basins lose their effectiveness after one or two cultivations.

When wheat crops fail because of lack of moisture or for other reasons, the soil is badly exposed to the winds. If emergency cover crops can be established, they help greatly. Usually the soil is too dry. The last resort in such a case is tillage — plowing, listing or otherwise throwing the land up into ridges. As the soil blows, it settles into the hollows between the ridges. In extreme cases, the hollows may fill and it is necessary to repeat the operation. These measures are relatively expensive and only moderately successful; they are definitely "rescue" in character, and designed to prevent a bad situation from deteriorating still further.

Extreme forms of soil blowing in the Great Plains are obvious to anyone. They cause great dust storms, such as those originating in Texas and Oklahoma in 1934 to 1937, which traveled to the Atlantic Coast and out to sea; or great accumulations of fine soil or sand along fence rows or even in great dunes. Inexperienced persons have assumed that little or no soil blowing occurs when these more extreme symptoms are absent. Actually, serious soil damage may result from numerous small windstorms over a considerable period of time, that produce no large accumulations. The wind action is selective; it picks out the lighter and more fertile particles and leaves behind the coarser particles, or perhaps rolls them along the ground. A wind-blown field often shows many small rocks and gravel, or even coarse sand, on the surface; the finer particles have been blown away, sometimes many miles away.

TENURE

The largest genuine increases in tenancy in the United States in the period from 1880 to 1928 were in the wheat-growing sections of the Great Plains. There were two reasons for this; one, that the homesteading program created many units too small to be operated as self-sus-

taining farms; the other, that wheat growing lends itself readily to crop-share rent. The owners of these tracts could hold on to them and get some returns in those years in which enough rain fell to make a crop, and always hope for better days. In North Dakota, for example, 36 per cent of the cash-gain farms in 1930 were full-rented and 35 per cent were part-rented. The comparable figures for Kansas were 48 and 28 per cent. Land rented on this basis is often badly misused and it is not likely to be protected against wind erosion. It much needs to be incorporated within the adjoining farms and made part of the constructive long-term programs for these farms. Credit should be generally available for the purchase of such land.

WHEAT GROWING IN THE EAST

Wheat growing has in the past persisted in the southern Corn Belt and eastward to the Atlantic Coast in Maryland, because of the need for a small-grain crop in the rotations and because the latitude is not right for either spring-sown or fall-sown oats or barley; also because of the circumstances outlined in Chapter IX which cause many farms to persist in cash-grain farming. The emphasis on reducing the acreage of corn in 1933 to 1940 may also have been a temporary factor in the situation. It would have induced more wheat growing than it did if soybeans had not appeared on the scene. How much wheat will be grown in these regions in the next decade depends upon the policy adopted with respect to production, price supports, surplus disposal, and the like, relative to corn, wheat, and soybeans. A parity-price program without production control will cause the wheat acreage to expand as it did in 1933 to 1937. If all controls are removed, the wheat acreage will resume its pre-1933 decline, but will still be grown on many farms for the same reasons as in the 1920's. Subsidizing the feeding of wheat would stimulate its production markedly in these regions. Considerable of the wheat now produced in the East is fed on the same farm.

Wheat is a definitely better crop than corn or soybeans for much of the rolling land in the border states. Rotations in which wheat and legumes replace corn to a large extent are indicated for large acreages of sloping land from Missouri eastward. Wheat responds satisfactorily to the use of commercial fertilizers. A formula high in phosphate, like 2–12–6, is commonly recommended, from 200 to 400 pounds per acre. Higher-strength formulas are cheaper and easy to apply to wheat. Chart 112 presents the results of twenty long-term trials conducted by the Ohio Agricultural Experiment Station. The first 100 pounds added

6 bushels to the yield; the second, 4 bushels; the third, 2.4 bushels; etc. The clover crops are larger after the wheat because of the phosphate left in the soil, and the corn crop following because of the better clover crop.

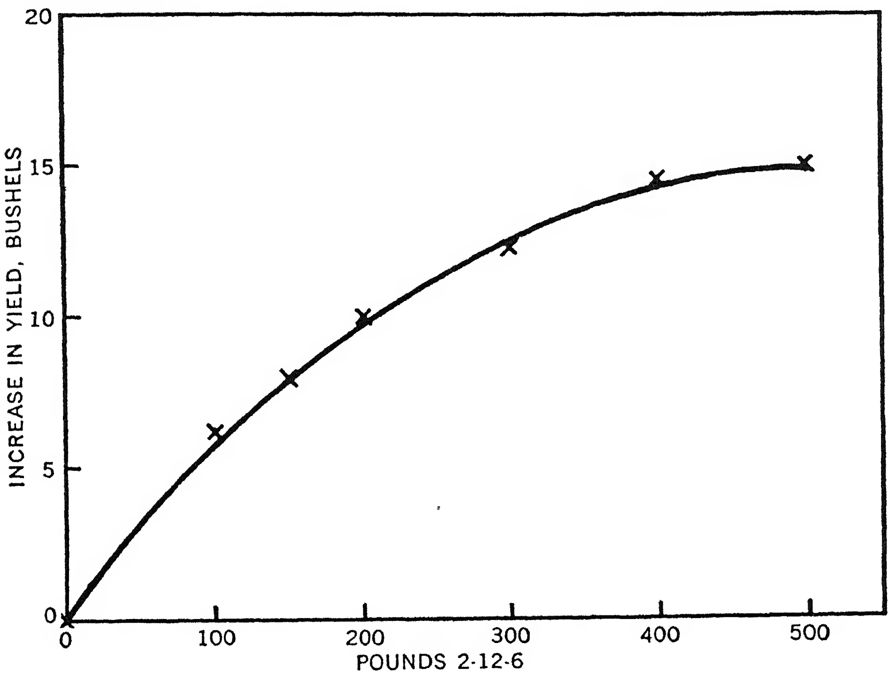

CHART 112. Response of wheat to 2–12–6 fertilizers in 20 long-term trials in Ohio. (Ohio Mimeograph 91, Table 11.)

INTERNATIONAL ASPECTS

Wheat is the staple food of almost as large a fraction of the world's population as rice. And yet taking the world as a whole, about all the wheat that is now consumed could be produced on land in the United States, Canada, South America, Australia, Africa, Russia, China, India, and a few other regions for which there is no alternative use except ranching, exactly as in the United States. A considerable amount of wheat is grown in countries or parts of countries not fitting into this description; but only because of tariffs and other artificial price supports; and as a result, the regions where wheat has a comparative advantage are bothered with surpluses and crop controls and other measures to deal with them. Freer trade in wheat would contribute importantly

to the better feeding of the world's population and a more productive use of its sub-humid and semiarid lands.

The most acute population pressures, however, are more largely in the rice-growing than in the wheat-growing areas. Russia and some of the Balkan states are the only wheat-eating nations that have prospects of a large population growth in the next century ahead. Industrialization of countries like China and India, however, would enable them to import more wheat.

CHAPTER XXXVII

Cotton Farming

Chapter VIII analyzed briefly the major management problems of highly specialized cotton farming in the Black Prairie of Texas. Chapter X analyzed cotton farming in combination with tobacco and peanuts in North Carolina and Georgia, and with wheat in western Texas. Chapter XIII analyzed the problems that arise when livestock and cotton production are combined. This new chapter will look at cotton farming as a whole, integrate these earlier analyses, and fill in the gaps that have been missed.

As stated earlier, 1,640,000 farms, or 28 per cent of all those in the country, were classified as cotton farms in 1929, because 40 per cent or more of the value of their production came from cotton. Cotton farms were not listed separately in 1939, but only 1,590,000 farms reported growing cotton, compared with 1,920,000 in 1929, and 1,931,000 in 1919. The acreage of cotton in 1939 was only 23,805,000 compared with 43,323,000 in 1929, and 33,740,000 in 1919. Yields per acre in 1939 were 238 pounds, compared with only 164 in 1929, so that total production in 1939 was 11,817,000 bales compared with 14,825,000 in 1929. Harvestings fell off over three million acres more during the war, but yields averaged 270 pounds in 1942–1945.

THE TOTAL SITUATION

Cotton growing in the United States is faced with the need for larger adjustments even than those for wheat growing. No group of farmers in this country has had greater or more recurring difficulties than the cotton growers have experienced since 1865. A farmer in Henry County, Alabama, told the field crew conducting an adjustment survey there in 1940 that it was a good time to study cotton production in the Coastal Plain because "It looks like everything possible has already happened to the cotton farmer." When the Federal Farm Board began in 1929–1930, it had to cope with a carry-over of 4 million bales of cotton, com-

pared with a normal (pre-World War I) of 1 to 2 million bales. When the Federal Farm Board closed shop in 1933, it transferred holdings of 2.5 million bales to the A A A, and the carry-over on August 1st of that year was 8,081,000 bales. After eight years of production control by the A A A, combined with loans by the Commodity Credit Corporation after 1933, the United States carry-over on July 1, 1941, was 12.0 million bales, of which 7.0 million bales were under government loan. On August 1, 1945, the United States carry-over was 11,000,000 bales, of which 6,000,000 bales were under government loan. Much of the accumulated loan cotton staples less than one inch and includes substantial amounts of the lower grades. These staple lengths and qualities were not popular with mill operators who were trying to save labor and had to meet more rigid specifications under wartime conditions.

Before we can determine the type of adjustments that this situation calls for, we need to know how this situation developed. Basically, it has arisen from the fact that our Southern states have more land whose climate and soil are adapted to cotton growing than any other region on the earth, and our people took advantage of this situation very early and proceeded to supply the world with the major portion of its growing demands for cotton at a low price. The introduction of the cotton gin in the 1790's and the increased use of slave labor were the two things that established our advantage in cotton production. Between 1810 and 1860, cotton production increased from 150,000 to over 5 million bales. By 1890, the plantation system had pretty well adjusted itself to the abolition of slavery and production had risen to 8.6 million bales.

Then came the boll weevil, into Texas first from Mexico in 1892. It reached Mississippi by 1910, Alabama by 1914, Georgia by 1917, and South Carolina by 1920. Wherever it appeared, yields fell off sharply for a period, and also acreages, until the farmers learned how to combat it. In many communities in the Georgia and Carolina Piedmont, a high proportion of the families moved out and the land reverted to brush and trees. In the warmer coastal-plains areas, no methods of control are altogether successful. But in many of these areas tobacco, peanuts, and truck crops can take the place of cotton.

The First World War increased the price of cotton and overshadowed the effects of the boll weevil for a while. Cotton prices fell over a half in 1920, from 35 to 16 cents. But yields were very low in 1921–1923, when the boll weevil damage was at its worst. Prices at the farm rose to 29 cents in 1923, and the acreage expanded rapidly to the all-time peak of 44,608,000 harvested acres in 1926. Prices were back to 18 cents in 1928, and fell to 5 and 6 cents in 1931–1932.

Meanwhile, important changes were taking place in cotton production elsewhere. World War I had given an impetus to cotton growing in other countries, and the boll weevil threat, the short supplies, and the high prices of 1922–1924, alarmed several of the importing countries. Then just at the time when these influences were at work, this country began holding its supplies from foreign markets by buying up supplies and putting them in a price stabilization pool, or financing cotton cooperatives in doing the same thing. Before 1929, American cotton had sold at a premium of 23 per cent (10-year average) over Indian cotton in the Liverpool market. From 1929 to 1931 when the Farm Board

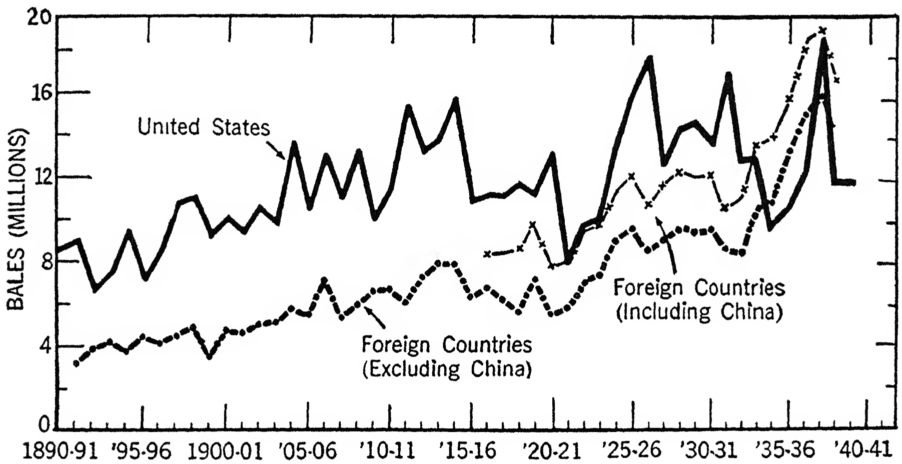

CHART 113. Cotton Production of the United States and foreign countries, 1910–1945.

was holding American cotton off the market, the premium was 40 per cent. As a result, foreign consumption of American cotton fell off 1.4 million bales in 1930, and consumption of foreign cotton increased 2 million bales. This was only temporary, of course. Exports of cotton rose to a new peak in 1932 when the Farm Board reached the limit of its funds and Congress voted no new funds. The production control efforts of 1933–1937 had little direct effect on exports, but in 1938 they were coupled with a new holding program supported by loans.

Chart 113 shows the changing balance of United States and foreign cotton from 1900 to 1945. The 1915–1923 period of greatest boll weevil damage is very evident. The sharp break in 1934–1936 was mainly due to drouths. In 1900–1904, the United States was producing 61 per cent of the world's cotton; in 1925–1929, 56 per cent of it; and in 1938–

1941, 40 per cent of it. The United States was exporting 67 per cent of its crop in 1900–1904, and only 42 per cent of it in 1935–1939.

The countries which have increased their cotton production most since 1900 are Brazil, 460 per cent; Russia, 160 per cent; India, China, and Egypt, each about one fourth. The increase in India came before 1925; then followed a decline and a recovery which brought the acreage back to its 1925 level. The Russian acreage doubled from 1930–1935 to the immediate prewar years; and the Brazilian acreage trebled in that period. The Chinese acreage declined in the prewar decade. The Egyptian acreage, like the Indian, has about held its own since 1925.

The interplay of acreages and yields in the United States, evident in Chart 114, is no less significant. Back in 1900–1908, before the boll weevil crossed the Mississippi River, yields averaged 188 pounds. In the 1915–1919 years, they fell to 168 pounds, and then in 1921, to 133 pounds. As the crop shifted to the west and north to areas less subject to the weevil, the yields rose to 171 pounds in 1925–1929. Then as the acreage fell off to 24, 23, and finally 20 million acres in 1944, and 18 million in 1945, the yields rose to an average of 263 pounds in 1940–1945.

Part of the increase in recent years arose from confining cotton to the better fields; part from getting the soil in better condition by combining soil-building crops with cotton in the rotations, part from using more fertilizer, and part from better disease and pest control. In 1933 when production control was first instituted, about 30 per cent of the cotton acreage received fertilizers, and in 1944–1945, about 45 per cent of it. The applications increased at the same time from 250 to 325 pounds per acre. Yields increased anywhere from 65 to 80 per cent between 1928–1930 and 1940–1944 in the Delta and the border areas, from 28 to 37 per cent in the old cotton states, and somewhat less in Texas and Oklahoma. In these last two states, the crop has been pushed steadily into new and drier areas. Yields in 1940–1944 averaged over 400 pounds in California, New Mexico, and Missouri; and over 300, in order of yields, in Virginia, North Carolina, Tennessee, Arizona, Arkansas, and South Carolina. The Texas average was 176 pounds, and the Oklahoma, 187 pounds. The production in California, New Mexico, and Arizona is on irrigated land.

DISTRIBUTION OF PRODUCTION In the meantime, important shifts in the location of cotton growing were taking place at home. These are of sufficient importance to be examined in detail by states in Table 83. Acreages reached their peak in the old cotton states, from Alabama eastward, around 1909, except for the small acreages in North Carolina,

Virginia, and Tennessee. The boll weevil cannot live through the cold winters of the border states. The Delta region of Mississippi expanded to new levels after the boll weevil was checked. The states west of the Mississippi gained what those east of it lost, and took the boll weevil almost in stride. In 1899, Texas and Oklahoma had 31 per cent of the

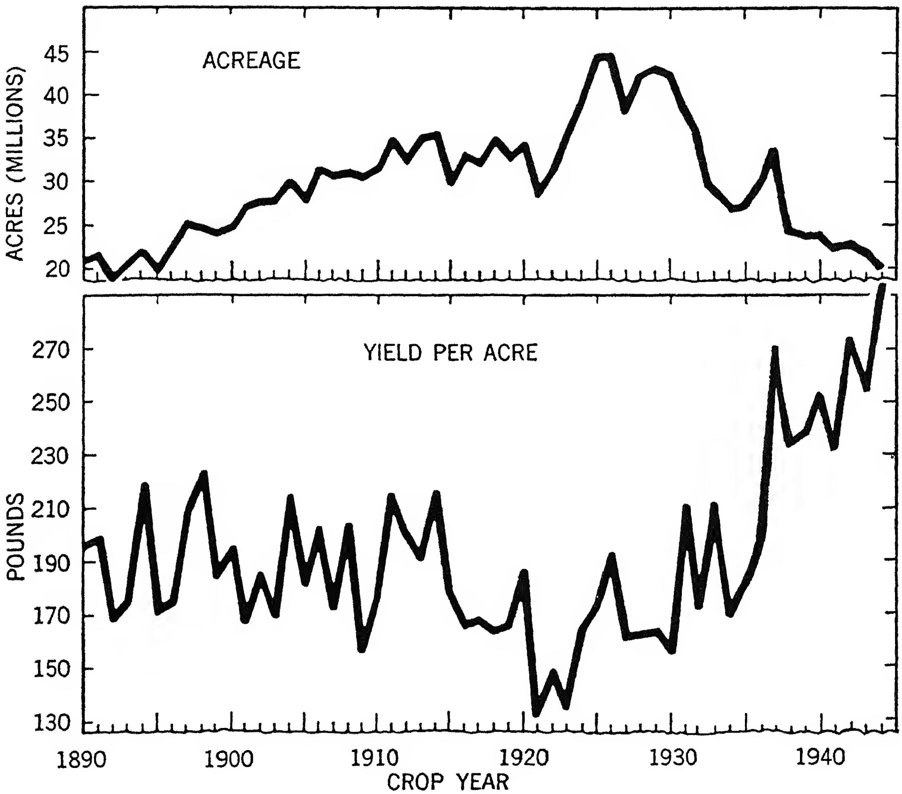

CHART 114. Acreage and yield of cotton in the United States, 1900–1945.

cotton acreage; in 1919, over 40 per cent of it, and in 1929, almost exactly half. Arkansas apparently increased its Delta acreage just as did Mississippi, and likewise Missouri. The reduction in the 1930's under the A A A program was around 40 per cent from Louisiana and Arkansas east. The drouths of the 1930's combined with the A A A to cut the acreage over half in Texas and Oklahoma. The Delta and the border areas appear to have reduced their acreages least during the war.

The cotton produced in Arizona, California and New Mexico is partly of American-Egyptian types, with staple length running between $1\frac{7}{16}$ and $1\frac{5}{8}$ inches. The acreage of this increased during the early war

years because of the threat of loss of Egyptian supplies. From the high figure of 162,000 acres in 1942–1943, the acreage fell off to 14,000 in 1944. Without heavy tariff duties, American-Egyptian cotton will hold no larger place in our economy than Sea Island cotton, a domestic long-staple type, which before the boll weevil came, was grown along the Carolina coast and on the islands offshore.

TABLE 83. HARVESTED ACREAGES OF COTTON BY STATES, 1899 TO 1944, CENSUS DATA. (000'S OMITTED)

State	*1899*	*1909*	*1919*	*1929*	*1939*	*1944*
Texas	6,960	9,930	11,523	16,834	8,106	7,200
Oklahoma	683	1,977	2,733	4,148	1,671	1,500
Louisiana	1,376	957	1,343	1,945	1,089	920
Arkansas	1,643	2,153	2,554	3,446	2,057	1,776
Mississippi	2,898	3,400	2,948	4,009	2,449	2,350
Alabama	3,202	3,730	2,628	3,566	1,931	1,425
Tennessee	623	787	808	1,045	677	677
Florida	222	263	111	123	59	33
Georgia	3,514	4,883	4,720	3,406	1,856	1,360
South Carolina	2,074	2,556	2,632	1,973	1,177	1,090
North Carolina	1,007	1,274	1,374	1,640	710	765
Virginia	26	25	47	88	30	32
Missouri	46	97	110	352	390	390
New Mexico	—	1	11	137	90	114
Arizona	—	—	106	211	183	147
California	—	—	87	300	316	301
All other	1	11	5	4	20	18
United States	24,275	32,044	33,740	43,227	22,811	20,098

The usual upland cotton grown in the United States ranges in staple length from $\frac{7}{8}$ to $1\frac{1}{8}$ inches. If we classify as short staple all that under 1 inch, 76 per cent of the cotton grown in the United States in 1928–1932 fell in this class. Medium-staple cotton — 1 to $1\frac{3}{32}$ inches — was grown scarcely anywhere except in the Delta. In Alabama and Georgia, less than 5 per cent was of medium staple. By 1938–1942, however, only 43 per cent was short staple and 51 per cent was medium staple, and the crop in the Carolinas was more than 70 per cent medium staple, and that of Georgia, 46 per cent. The Delta has always grown some cotton of $1\frac{1}{8}''$ staple or longer. The shift to longer staple production has been made possible by the breeding and the use of suitable varieties.

CONSUMPTION OF COTTON The shift to medium-staple cotton has been induced largely by market differentials. Twenty years ago, long-staple Egyptian-type cotton was considered essential for automobile tires and other similar uses. Present methods of manufacture make medium-staple cotton serve about as well.[1] As a result, some areas in the West were shifting to higher-yielding medium-staple varieties before the war. Short-staple cotton still has many uses, but the demand for it has declined relatively. A factor in this has been the increasing industrial use of cotton, 37 per cent in 1939, as compared with 38 in apparel and 25 in household furnishings.

Cotton is meeting increasing competition from synthetic fibers. World rayon production was a sixth as large as world cotton production before the war, and rayon and other synthetics replaced cotton still further in much of Europe during the war.

Rayon staple fiber prices are now actually lower, per pound of usable fiber, than those of middling $\frac{15}{16}$-inch cotton. From 1928 through 1939, rayon prices ranged between two and seven times greater than those of cotton. Rayon has supplanted cotton exclusively in heavy tires, and threatens to do so in automobile tires. The use of rayon and other fibers in wearing apparel is familiar to all. Other fibers are offering stiff competition to cotton for bags and other coarse-cloth products.

ADJUSTMENT PROBLEMS

The over-all problem facing cotton growing in the United States is therefore that of meeting the competition of other countries and of other fibers. It could escape the first of these if production were to decline to the level of domestic consumption — from 7 to 11 million bales, depending upon the level of business and employment — and tariff duties were imposed to shut off imports. But the second form of competition is as strenuous as the first. If the tariff duties raised the domestic price much above the world level, synthetic production would be powerfully stimulated. In either case, American cotton would lose more of its market and cotton growing would have to contract.

The alternative to such a program is to reduce costs to meet these two forms of competition, and at the same time to increase the volume of production, of exports and of domestic consumption. With lower costs and greater efficiency in production, each worker will be able to produce more cotton. He will probably also be able to handle a larger

[1] *Agricultural Outlook Charts,* 1946, U.S.D.A.

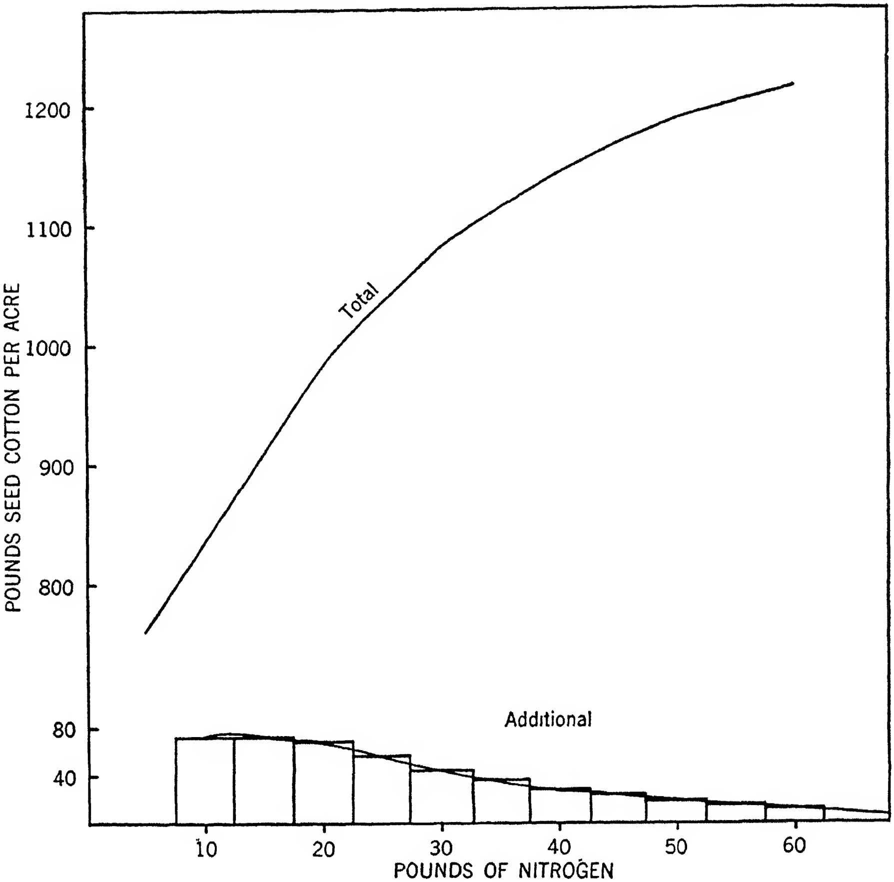

CHART 115. Total outputs and additional outputs with increasing inputs of nitrogen used with fixed amounts of phosphate and potash — South Carolina trials. (Based on data in South Carolina Bull. 282 by W. B. Rogers.)

acreage. His earnings may therefore increase even though prices are lower. A combination of 12 cents a pound and 5,000 pounds of cotton per worker, obtained from 15 acres of cotton yielding 330 pounds of cotton per acre, will be better for the South than a combination of 20 cents a pound and 2,500 pounds of cotton per worker, obtained from 10 acres of cotton yielding 250 pounds per acre.

Let us now consider the several ways in which costs can be reduced and earnings per worker can be increased.

USE OF FERTILIZER [2] All available evidence indicates that costs per pound can be further reduced by further increases in the yields of cotton,

[2] The data and curve here presented were assembled by Dr. Frank W. Parker of the Bureau of Plant Industry, Soils and Agricultural Engineering

achieved by a more liberal use of fertilizer, more thorough insect and disease control, and planting high-quality seed of recommended varieties, and similar methods. Several of the experiment stations have conducted trials that indicate the general nature of the response as increasing amounts of fertilizer are used. Chart 115 presents the results, expressed in pounds of seed cotton, of fifteen one-year trials in South Carolina with from 0 to 60 pounds of nitrogen applied per acre, and 64 pounds of phosphate and 37.5 pounds of potash applied uniformly to all. The curve of additional returns has no increasing portion; the plant nutrients already in the soil were sufficient for production at the point of highest additional or marginal returns. The additional outputs fall off about one fifth with each additional 5 pounds of nitrogen applied. The last 5 pounds added, however, increased the yield only 12 pounds of seed cotton, equal to 4.2 pounds of cotton. At 12 cents per pound, this cotton would pay for 3.1 pounds of nitrogen costing 20 cents at retail if the other costs were covered by the value of the additional cottonseed. Column 2 in Table 84 gives the additional output with each increment of fertilizer. Balancing additional fertilizer costs with the value of the cotton outputs will indicate which increment of fertilizer would maximize profits by just paying for itself.

Chart 116 and the third column of Table 84, give the additional outputs obtained in twenty-seven Louisiana Station trials on Coastal Plain

TABLE 84. ADDITIONAL OUTPUTS OF SEED COTTON ACCOMPANYING INCREASING INPUTS OF NITROGEN IN TWO TRIALS, AND 4–8–4 FERTILIZER IN TWO TRIALS.

Nitrogen	*South Carolina* [a]	*Louisiana* [b]	4–8–4	*Alabama* [c]	*Georgia* [d]
5			100		
10	74	58	200	94	70
15	74	58	300	88	72
20	68	49	400	78	72
25	58.5	37	500	69	70
30	45	23	600	60	62.5
35	36	12	700	51	53
40	29	5	800	43	43
45	23		900	37	35
50	19		1,000	30	27
55	15		1,100	24	18.5
60	12		1,200	18	12

[a] South Carolina Bull. 283. [b] Louisiana Bull. 285. [c] Alabama Bull. 228. [d] Georgia Bull. 196.

soils. The increments are smaller and the rate of decrease in additional returns above 20 pounds is more rapid than in the South Carolina trials, and the highest-profit point will come much sooner. The other two curves in Chart 116 and Columns 5 and 6 in the table, give the additional outputs with increasing inputs of 4–8–4 fertilizer in Alabama and Georgia trials.

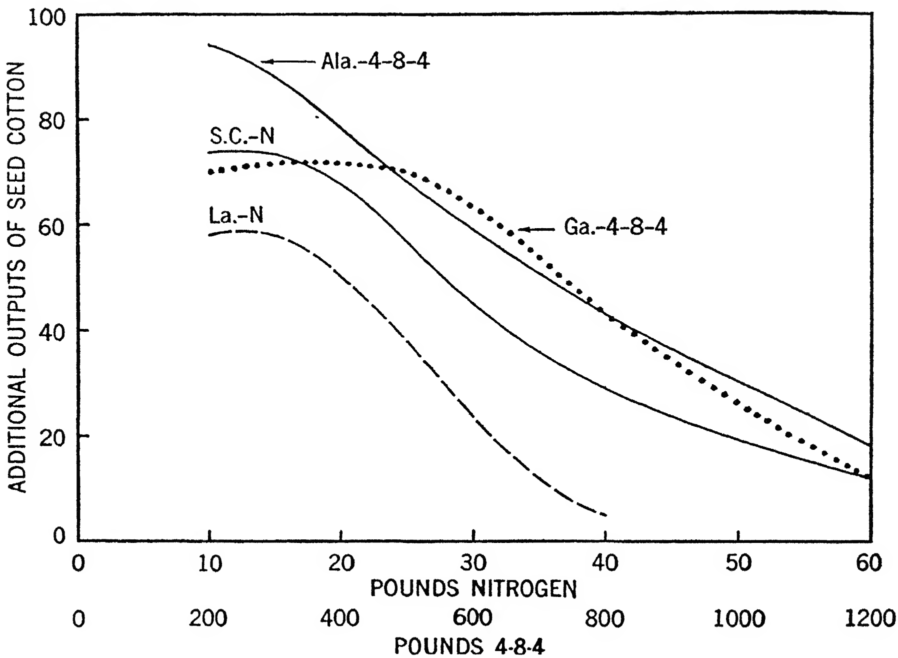

CHART 116. Graphic presentation of data in Table 84.

If these results correctly represent the condition of the soils which were used in the trials, the Alabama soils were better supplied with plant nutrients when the trials started than were the Georgia soils, since they began showing diminishing increments right from the start, and the Georgia soils not until 500 pounds had been applied. Once decreasing increments began, however, they were more rapid in the Georgia soils. This indicates a smaller capacity for fertilizer.

One cannot emphasize too strongly the fact that these results apply only to the particular soils used in the trials, and their condition when the trials began, and the further fact that special circumstances of weather and disease and pest damage may have influenced the shape of the curves. These influences will be particularly potent on the lighter and warmer soils of the Coastal Plain region. The actual results were

also, of course, more erratic than appears in the charts — the irregularities were smoothed out in fitting the curves. It seems safe to conclude from these results, and scattering results of other trials, that applications of fertilizers heavy enough to produce yields of 250 to 450 pounds will pay out on the fairly good to better soils of the Old South with cotton selling at 12 to 15 cents per pound. An analysis for the four states from Mississippi east made by the Bureau of Agricultural Economics in collaboration with the states indicate that average yields as high as 375 pounds would be advantageous with full employment and prices close to parity. This 375 is compared with 275 in 1943.

Surveys conducted by the Bureau of Agricultural Economics in collaboration with the states in 1943 indicated that only from 50 to 85 per cent of the farmers were using "high-quality seed of recommended varieties," and that only 20 to 25 per cent were treating their seed and dusting as needed for disease and insect control.

Differences in variety performance both from the standpoint of yield of lint and of spinning quality are being recognized more and more. Eventually the production of outstanding varieties on a community basis may provide added economies through the availability of good seed, avoidance of quality losses in ginning, and the establishment of selling practices which will more closely reflect the characteristics of that particular cotton.

CHANGES IN FARM ORGANIZATION Incomes per farm and per worker can also be increased by several types of reorganization of cotton farms. Foremost of these is to grow cotton only on the land well suited to cotton that will return good yields or a larger output per worker. Much headway in this direction was made in 1933 to 1942 under the influence of crop control. Further developments of the same sort are easily possible. The acreage of cotton on some farms may be further reduced as a result, or the farm may need to take in more land in order to provide the same acreage of good cotton land. In general, such a development means increasing the acreage of other crops, and usually the keeping of more livestock, in the manner indicated in Chapter XIII on "Crop-and-Livestock Farming."

It cannot be assumed that unit costs will rise if the cotton acreage is reduced. Accurate cost accounting will show that a major factor in costs is how an enterprise fits in with other enterprises in the use of labor, equipment, and land. A smaller cotton enterprise that does not create a heavy peak-load demand for labor is likely to have lower real labor costs than a large cotton enterprise that crowds out essential work on

other enterprises. Only by testing such analysis in terms of the consistency of its results with effects on net farm incomes can one find out which costs have really been increased or lowered by growing cotton only on the good fields.

Whether shifting part of the land out of cotton will prove advantageous will depend much on how well the other enterprises are handled. Trials conducted in fertilizing corn in South Carolina and Alabama show yields of 30 bushels per acre with 30 pounds of nitrogen per acre, and only moderately decreasing increments thereafter.[3] The Mississippi and South Carolina trials report 60 bushels of oats with 40 pounds of nitrogen.[4] Much of the land shifted out of cotton should be used to grow forage or pasture grasses. The possibilities of increasing yields in such uses are greater than with grains.

MECHANIZATION

The operations of fitting land, planting cotton and cultivating it offer problems in mechanization not appreciably more difficult than those for corn. The operations that have defied mechanization most effectively are chopping, weed control, and harvesting. These are interdependent. To mechanize the chopping only would still leave the need for large amounts of labor for hoeing and at harvest time. As long as one of these labor peaks remains, substantial improvements in cotton production efficiency will be delayed.

The State Experiment Station and the U.S.D.A. are carrying on intensive research in mechanization at Stoneville, Mississippi. Anything now written on the subject will be largely obsolete in a few years. Three procedures are being developed to take the place of hand chopping. One is to drop the seed in hills. The second is to use the flamer, with a special blocking attachment, to destroy the plants in the drill except those protected by rotating hoods. The third, and probably most widely used method, is cross-cultivation of drilled cotton. Weed control presents more serious problems, particularly if the early part of the season is abnormally wet. Trials conducted at the Delta Branch Station at Stoneville in 1943 showed as high yields with cultivation and flaming as with cultivation and hoeing.[5] Flaming can be started when the ground-level diam-

[3] W. B. Rogers, *Experiments on Rate and Time of Applying Sodium Nitrate*, South Carolina Bull. 283, 1932; *Grades of Fertilizers for Corn and Cotton, a Progress Report*, Alabama Circular 70, 1935.

[4] *Op. cit.*, South Carolina Bull. 283; Mississippi Bull. 348.

[5] J. Winston Neeley and Sidney G. Brain, *Control of Weeds and Grasses in Cotton by Flaming*, Mississippi Circular 118, 1944, and *The Use of the Flame Cultivator and Flame Chopping Device*, 1944, Delta Experiment Station, Stoneville, Mississippi.

eter of the cotton is about $1\frac{1}{16}$ inches, at which time it is usually about 6 inches tall. Flaming will not kill Johnson grass if it has a head start. Also, if the weed growth is rank and thick, it is difficult to clean cotton without hand hoeings. The flaming machines themselves are being improved rapidly. They can now be operated with butane or propane for fuel, which gives a more dependable flame.

The problem of mechanical cotton picking seems to be fairly well solved for western Texas and Oklahoma. On the high plains of Texas, much of the cotton has been hand-snapped for the last fifteen years. The cotton is then removed from the bolls by a burr extractor. Back in the early thirties when cotton was very cheap, the farmers improvised a sled for stripping the bolls from the cotton; and one of the machine companies manufactured several hundred single-row horse-drawn cotton strippers. These strippers went out of use with the rise in the price of cotton. Recently, with the labor shortage, a new type of two-row tractor-mounted roller stripper has come into use. A tractor-mounted field extractor, to separate the burrs from the cotton as it is harvested, can be combined with it. The two units together make what is essentially a "cotton combine." This machine in 1943 was harvesting an average of 10 acres per day for a 30-day season, at a cost of $6.00 per bale, with yields of 200 pounds of lint per acre, assuming hand labor at the wages prevailing at that time. The equipment is suited to the short growth of the cotton in this region. Stormproof varieties being developed make cleaner picking possible.

As to the effect on the quality of the cotton, Troy Mullins writes as follows: "Harvesting exclusively with machines necessitates leaving the entire crop in the field until after frost, thus subjecting the cotton to considerable weathering. The average value of cotton harvested before November 13 during the period 1941–1944 was $11.30 per bale more than the average value of cotton harvested after this date. In addition, machine-harvested cotton during the 1944 season graded about two-thirds of a grade lower than did hand-snapped cotton harvested during the same part of the season and was valued at from $4 to $5 per bale less. Waste during the harvesting process is estimated at 5 to 10 per cent depending upon the variety. Also the waste hazard before harvest is significant and is associated with the variety of cotton and the extremely variable weather conditions." [6] Growing only one variety in a community, as now strongly urged, will be a further aid to mechanization.

[6] Troy Mullins, *Harvesting Cotton in the High Plains Area of Texas, Progress Report No. 952,* U.S.D.A., 1945.

The pickers that have been used mostly in the last two years were developed by the International Harvester Company. They were of two sizes, the larger being mounted on a Model M Farmall tractor and the smaller on a Model B Farmall tractor. One was built with a high drum for tall cotton and the other with a low drum for short cotton. The cost of the smaller machine in 1944 was $2,325, including the tractor. Some question is arising as to whether this low-drum machine will prove satisfactory in many short-cotton areas because the cotton may be 3 or 4 feet tall in low places in the fields. The high-drum machine used in the Delta in 1944 cost $3,924 delivered, including $1,250 for the tractor. All-purpose farm tractors can be adapted to use with a picker. The conversion costs are around $100. The tractor can still be used for other farm work.

Twelve machines upon which records were kept by the Mississippi Agricultural Experiment Station in 1944 operated an average of 430 hours, and picked 4.3 bales per 10-hour day. The cost of operating the pickers was figured at $7.38 per bale, including interest and depreciation.[7] The cotton thus picked graded 1.4 grades below that from the same fields which was hand-picked. The staple length, however, was 0.2 of a staple length longer. The machine-picked cotton sold at 18.05 cents per pound, and hand-picked, 21.73 cents. Also 7 per cent more cotton was left in the field. The savings in picking and the losses combined to give a total cost of $33.40 per bale compared with $37.80 for hand-picking.

The reason that the cotton graded low was mainly the inclusion of green leafy material and trash in the cotton. The cotton gins need devices for drying the cotton before ginning it, and for removing the trash. They have been working along with the harvester company engineers, and were on the threshold of solving the problem in 1944 by means of an "impact cleaner." The loss in grade was slightly less than 1.0 in 1945, and further improvements were still in prospect. Loss in grade was more than half the cost of the machine picking in 1944. The cost of the pickers cannot be judged very closely from the prices in 1944. Larger volume of output will reduce costs, but the prices charged in 1944 may not have included all items of cost.

Most of the machine-picked cotton had been defoliated by dusting the plants with calcium cyanamide dust. This has important advantages, but still leaves many leaf fragments in the cotton. Defoliation is an aid to hand-picking also. The type of cotton plant is also important for

[7] Frank J. Welch and D. Gray Miley, *Mechanization of the Cotton Harvest*, Mississippi Bull. 420, 1945.

machine-picking. The ideal plant is one having short fruiting branches, no long vegetative branches, light foliage, storm resistance, and large open bolls.

Existing gins can be converted to handle machine-picked cotton, but additional investment, variously estimated in 1945 at $5,000 to $15,000, is involved. Small gins cannot afford to make this investment. The gins will therefore become larger as machine-picking expands. The two- and three-gin stands will tend to give way to five- and ten-gin stands costing $50,000 or more.

The potentialities of mechanical harvesting are greatest in areas with level land, well-shaped fields, uniform growth of plants, concentrated production to stimulate good ginning, and farms with large acreages of cotton. The effects of these factors will be reviewed in detail in the discussions by areas at the end of the chapter.

RELATION TO LABOR SUPPLY The rate of mechanization will be conditioned strongly by wages of cotton labor and the other opportunities open to such labor. High-level employment and industrial expansion in the South, and in other centers to which cotton labor can migrate, will hasten mechanization. The machines will, however, tend to displace labor on their own account, and this may lower wages to a point where hand-chopping and picking will pay better than using power and machines, unless alternative employments are kept open.

In similar manner, the supply of labor and wages of labor will strongly condition any shifts of land from cotton to other lines of production. The South obtained its supremacy in the world's cotton markets in large part because of developing a cheap supply of the hand labor needed. This cheap labor established the level of return for all labor in the South, white as well as Negro, in the decades after 1870. The descendents of these low-income workers, increased greatly in numbers in spite of extensive migration, tend to force on the South a continuance of cotton growing and other lines of production that provide much work per acre. During the war, migration was unusually heavy, and toward the end, the supply of labor was a factor in reducing the acreage of cotton. If those who left the farm in these war years return sometime within this first decade after the war, only a small fraction of the cotton-growing areas will shift largely to other products. If, instead, they mostly stay in the cities or find nonfarm occupations or employments, the shift to more livestock and diversified farming may proceed rapidly. Cotton will tend to become a supplementary cash crop, and to be harvested by custom-hired mechanical pickers.

ADJUSTMENT BY AREAS

In a region as diverse as that in which cotton is grown in the United States, and with systems of farming including cotton differing as widely as indicated in earlier chapters, obviously the types of adjustments called for vary widely. In Chart 117, the type-of-farming areas growing more or less cotton are combined into 22 larger areas within each of which the adjustment problems are approximately uniform, and these in turn are classified under three heads, as follows: A, those which produce little except cotton, like No. 22, the High Plains of Texas, and No. 9, the Delta; B, those in which, like Nos. 21, 18, 14, 8, and 7, cotton as the major enterprise is accompanied by livestock, peanuts, truck crops, or something else; and C, those, like Nos. 12, 20, 6, and much of 2, in which cotton is a minor enterprise, taking second or even third place after livestock, general farming, tobacco, and the like. Adjustments calling for a shift to other lines of production are ordinarily most difficult in the first of these groups. But at the same time, these may be the areas in which cotton growing has the highest comparative advantage and which most easily out-compete other areas. It will not be possible here to analyze in detail the adjustment problems of the 22 areas. Instead, a few will be singled out for brief discussion whose problems have not been dealt with specifically somewhere in the earlier chapters.

But just a few more general observations. Several areas in the South, with only moderately productive soils which are now depending on cotton, corn, dark tobacco, and vegetable enterprises need to subordinate these to the extent that they can be handled by the labor available after balanced farming systems with livestock and woodland enterprises and peanuts and canning crops have been developed to a reasonable maximum. Such adjustments will aid greatly in solving the rural problems generally associated with very low farm incomes. They will increase labor efficiency, adjust production to meet long-time market demands, and stimulate the conservation and development of the resources of these areas. These areas include most of the Piedmont's cotton and tobacco sections, the Pennyroyal Plain in Kentucky and Tennessee, the Black Prairie in Alabama and Mississippi, the Brown Loam areas in Mississippi and Tennessee, much of the Coastal Plain from Virginia through Mississippi, large portions of the Rolling Sand Lands in eastern Texas, Louisiana, and Arkansas, and some of the cotton-and-wheat-producing areas of Texas and Oklahoma. A substantial part of the farmers in the South live in these areas. They have a challenging period ahead of them. In the more specialized cash-crop farming areas, where

it in the upper part of the Piedmont, this subregion has been dominated by cotton, but present trends are toward increasing livestock numbers, greater production of food and feed for farm and home use, and more soil-conserving crops. The lack of good pastures tends to limit the expansion of herd and dairy enterprises. The attitude is all too common that making a pasture consists of fencing in a few acres of gullied and unproductive land that is unfit for cotton, corn, or tobacco. The establishment of pastures on the uplands takes time, money, and skill. The bottom lands are made into pastures more easily. Most of them that are now cleared are needed for food crops, but thousands of acres of bottom lands are covered with brush and undesirable hardwood species which can be cleared with a small outlay by using family labor when it is not otherwise employed.

The lack of pasture, plus lack of marketing and processing facilities in many situations, retards the growth of dairying. Many of the farmers now operating small dairy enterprises are scattered too widely to warrant organizing milk or cream routes.

Present cash incomes on most of the small- and medium-sized Piedmont farms are so low that the operator cannot accumulate the capital for making substantial adjustments in his farming system. Credit arrangements for such adjustments will have to be made with the full realization that the returns will not be large and that a long period will be required to repay the loan.

Finally, the usual renting arrangements do not encourage changes in systems of farming. Present agreements are based on cotton and tobacco farming and will have to be modified if stable tenures under other systems of farming are to arise.

With prices at the 1940 level, small cotton farmers in the Piedmont had incomes ranging usually from $275 to $400. Their farm businesses were generally the simplest possible type of specialized farm organization, as indicated by Table 85. Generally 75 to 85 per cent of the incomes came from cotton, which is somewhat more than usual for Piedmont farms. About the only cash outlays for labor were at picking time if the family was not large enough to handle the crop during this peak period. The corn and cotton compete seriously for attention during the spring and early summer. Oats and cowpeas, however, fit in well with the other two enterprises. Such an organization leaves many periods during the year when there is little or nothing to do in the field. There is free time, for example, from the last of July until cotton-picking time, and again after the cotton picking until time to cut the stalks in late winter.

As indicated in Chapter XIII, the amount that can be accomplished

by reorganization of such farms is relatively minor so long as the farms remain as small as now, except as drastic programs such as proposed for the Heard County farms are adopted.[8] Only about enough hay and grain can be grown to provide for livestock for home-use production. Many of these families fail to do even this. They skimp along on the meager cash incomes which they can obtain from their cash crops and from occasional work off the farm. These farm businesses can be improved by fitting supplementary enterprises around cotton, but the families are still left with a low level of income. Even if the postwar prices were double their prewar level, most of these families would still have less than $700 income per year. About one third of the families in the Piedmont area live on such farms.

An unusually large number of farm people left the Piedmont areas during the war. Others turned to jobs in light industries in the area. If

TABLE 85. SMALL-COTTON FARM, LOWER PIEDMONT, SOUTH CAROLINA, 1940.

Crops	*Acres*	*Yield per acre*	*Livestock*	*Numbers*
Cotton: Lint (short staple)	10.4	300	Mules	2
Corn	10.0	14	Milk cows	2
Small grain	10.0	30	Heifers	1
Cowpeas (after oats)	(10.0)	.9	Brood sows	1
Cowpeas (interplanted in corn)			Pigs	6
Garden and patches	1.2	—	Hens	50
Cropland	30.6	—	Young chickens	53
Permanent pasture	10.0	—		
Woodland not pastured	47.6	—		
Other land	1.0	—		
Land in farm	89.2			

Income and Expenses

Cotton: Lint	$390
Seed	148
Oats	20
Pigs	16
A A A payment	37
Gross cash income	$611
Cash expenses	328
Net cash income	$283

Source: Based upon data accumulated in cooperative adjustment studies — Department of Agricultural Economics and Rural Sociology, S. C. Experiment Station, and the Bureau of Agricultural Economics.

[8] See Ch. XXIX.

most of these do not return, those remaining will have a chance to increase the size of their businesses and to become less dependent upon cotton for income. The land is not so well adapted to mechanization as in many other Southern areas.

LIMESTONE BASIN AND TENNESSEE VALLEY This area appears in Chart 117 also as largely given over to cotton. But that it has possibilities of shifting to other lines of production is evident from the changes that took place between 1929 and 1939. The nearly half of the cropland that went out of cotton reappeared in an increase of 26 per cent in corn, 130 per cent in hay, and the rest in plowable pasture. The acreage of peanuts for harvest increased from 8,000 to 64,000 between 1941 and 1943, and fell back to 35,000 in 1944. During the war, livestock production also expanded rapidly until 1943, when it reached the limit of its own feed supply. Hog and poultry production fell off sharply in 1944. Milk production, however, was 15 per cent higher in 1944 than in 1941. It is partly the somewhat more northern latitude, and partly the types of soil, that have favored these shifts. But these conditions have also favored cotton growing. Cotton yields averaged 330 pounds in this area in 1941–1943 — the highest of any part of the South except the Delta. Yields increased 150 per cent from 1928–1929 to 1941–1943. In 1940, only 15 per cent of the income was derived from livestock and livestock products. The potentialities of diversified farming in this area which are pointed out in the discussion of the Sand Mountain Farm in Chapter XIII have therefore been little realized as yet. Of course, the transitions involved will be much different on the valley farms.

In normal times, this area can import feed from the Corn Belt cheaper than most of the South because of the cheap barge rates — one third the railway rates — on the Mississippi and Tennessee Rivers.

THE DELTA A combination of fertile soils and an ample supply of labor and good management has given the Delta areas from the Missouri Bootheel southward along the Mississippi a high comparative advantage in cotton production. These areas now provide about one fourth of the lint from one seventh of the cotton acreage in the United States. It was estimated by the Mississippi Agricultural Production Capacity Committee in 1943 that 85 per cent of the cotton produced in the Delta areas of the state would normally staple $1\frac{1}{16}$ inches or longer and that 90 per cent of it would grade "strict low middling or better." Cotton yields are high throughout the Delta except where the drainage is inadequate. For the period 1941–1943 the yield of lint averaged 413 pounds

per acre, approximately 80 per cent higher than in 1928–1932, and more than 14 per cent above the 1935–1939 average.[9]

Historically, the large plantation has dominated the production organization of this region. Welch, analyzing the 1940 A A A records in Sharkey, Tunica, and Washington Counties in the Yazoo section of Mississippi, found that only 8 per cent of the operators had units exceeding 500 acres, but that their plantations accounted for 57 per cent of the total crops grown and 56 per cent of the cotton acreage.[10] Wage and share-cropping arrangements are both widely used with sizable shifts from one to the other with changes in the level of cotton prices, wages, and the difficulties in maintaining a dependable labor supply. If wages do not drop rapidly in 1946 and 1947, the prewar trend towards mechanization in the Delta will be accelerated. The land is level and well adapted to tractor farming. The planters have the money, and most of them will regard the use of tractor equipment for plowing, seed-bed preparations, and much of their cultivation as a logical step toward the use of mechanized picking, chopping, and weed control when their economic feasibility becomes apparent. Such mechanization will give the Delta still greater comparative advantage over much of the Cotton Belt and will alter many of the features which have been unique to the plantation system.

The only comprehensive study of plantation organization in the Delta was made before the war, and is in terms of wages and labor-supply conditions of that period. Langsford and Thibodeaux estimated the net plantation incomes for seven different organizations of a 950-acre cotton plantation in the Mississippi Delta, using prices and costs reflecting the long-time relationships in the area.[11] The net incomes from the several organizations ranged from $4,900 to $13,030. At wage rates, equipment costs, and other costs that prevail now, or are likely to prevail in the next decade, these net incomes will differ considerably, and the relative advantage of the different systems will be much changed. Our concern here, however, is with methods of analysis. Out of the 950 acres, 750 were used for crops, 115 were in woodland and waste, and 85 acres were used for pastures and for the farm facilities. A Delta plantation of this size is usually operated by the owner or a resident manager with the help of an overseer.

[9] E. L. Langsford, *Changes in Cotton Production in War and Peace*, U.S.D.A. Mimeograph, 1944.

[10] F. J. Welch, *Plantation Land Tenure System in Mississippi*, Mississippi Bull. 385.

[11] In each system, rent-free garden space is provided for the resident wage laborers and share-croppers, and each family would be permitted to produce two acres of corn on a share basis.

Data are given in Table 86 for five of these systems. System I*A* represents a plantation operated with share-croppers with half-row and one-row mule-drawn machinery. Feed grain for livestock is purchased in this system. System I*B* is about the same as I*A* except that all grain fed to livestock is produced at home. The acreage in cotton is smaller in I*B* to make room for corn. The equipment is the same for both

TABLE 86. INVESTMENT, RECEIPTS, AND EXPENSES IN PRODUCTION, PURCHASES, AND DISPOSAL OF CROP IN VARIOUS COTTON PLANTATION SYSTEMS, MISSISSIPPI DELTA, PREWAR.

Item		*IA*	*IB*	*IIA*	*III*	*IVA*
Investment: Land		$43,475	$43,475	$43,475	$43,475	$43,475
Buildings and improvements		9,929	8,650	6,100	5,836	7,300
Machinery and equipment		1,508	1,508	1,454	4,213	3,439
Workstock		3,412	3,412	3,412	612	1,312
Total		58,320	57,045	54,441	54,137	55,526
Gross income		29,356	25,192	30,785	34,172	32,825
Cash expenses		22,051	18,496	20,304	19,600	20,433
Depreciation		1,885	1,798	1,624	1,541	1,656
Total expenses		23,936	20,294	21,928	21,141	22,089
Net income		5,420	4,898	8,857	13,031	10,736
Cotton lint:						
Production [a]	bales [b]	197	169	426	473	375
Purchases from croppers	do	197	169			75
Sales	do	395	339	426	473	450
Cottonseed:						
Production [a]	tons	105	90	226	251	199
Sales	do	193	165	208	231	220
Purchases from croppers	do	105	90			40
Plantation use	do	17	14	18	20	19
Corn:						
Production [a]	bushels	760	2,540	400	460	560
Purchases	do	1,775		2,135		415
Plantation use	do	2,535	2,540	2,535	460	975
Alfalfa hay:						
Production	tons	90	90	90	16	36
Plantation use	do	90	90	90	16	36
Soybean hay:						
Production	do	45	45	45	8	18
Plantation use	do	45	45	45	8	18

Source: Adapted from Tables 38 and 39, *Plantation Organization and Operation in the Yazoo-Mississippi Delta Area*, E. L. Langsford and B. H. Thibodeaux, U.S.D.A. Tech. Bull. 682.

[a] Wage crops plus plantation operator's share of croppers' crops.

[b] 500 pounds, gross weight.

systems. System I*A* uses 38 croppers and System I*B* only 32. Gross plantation income and plantation expenses differ appreciably. With the interwar price relationships, it was more profitable to purchase feed grains for livestock than to grow them on plantation units similar to this when share-croppers were used as the main source of labor.

System II*A* includes the use of wage labor, one-row mule-drawn machinery, and the purchase of feed grain for workstock. For the 38 croppers, it substitutes 3,750 days of wage labor on cotton work other than picking, and 390 days of work on alfalfa, soybean hay, and winter cover crop, at $1.00 per day, the hiring of the picking of 426 bales of cotton at 90 cents per hundred pounds of seed cotton, or $14.60 per bale, and $340 spent on hauling cotton pickers. Twenty wage-labor families are housed under this system. The cotton acreage is raised from 564 under I*A* to 609. The gross income is higher and the cash expenses less, making the net plantation income $3,437 larger. System II*B*, not given in the table, includes growing about the same feed crops as System I*B*, with about the same reduction in net income.

System III includes the use of tractor power for plowing, seeding, and cultivating, and wage labor. With such an organization, enough resident wage laborers are generally retained on the plantation to handle the preharvest and regular work. The total days of such labor are reduced by 890. The cotton acreage is increased to 676, to the upper limit consistent with the maintenance of soil productivity. (It is assumed that acreage controls are not in effect.) The equipment consists of tractors and four-row tractor implements. The expense of caring for the cotton crop is reduced somewhat, and the net income is raised around $4,000.

System IV*A* tests the income possibilities with a combination of wage labor and share-croppers, mule and tractor power, and the purchase of feed grain for the workstock. Of the 643 acres of cotton, 214 are grown by croppers and 429 using wage labor. Cropper labor is substituted for about 1000 hours of preharvest wage labor, and for a proportionate share of the picking. The net income resulting is intermediate between those of Systems I*A*, II*A*, and III. System IV*B* includes the growing of feed crops as under I*B* and II*B*, with about the same reduction of income resulting.

Langsford and Thibodeaux concluded that plantation systems such as IV*A* and IV*B* were the most feasible under prewar conditions and would become more common. The unusual conditions arising from the war stopped the shift in this direction. When labor became scarce and cotton prices rose, many operators in the Delta and other cotton-growing areas shifted to the use of more share-croppers to retain their labor

supply. This is an example of an important consideration which cannot be given a precise weight in a budget. A budget makes it possible, however, to appraise the importance of such factors more realistically.

The effect of further mechanization in the organization of such a plantation cannot be judged conclusively on the basis of data now available. As stated earlier, the effects of mechanical chopping and picking must really be considered together. Miley and Welch have, however, attempted to show the effect of mechanical picking considered by itself, in terms of the data on such picking derived from the experience with the pickers and gins in use in 1944. If prewar wages of labor are assumed for a plantation such as here described, the results would be about like those in Table 87. On a plantation operated with wage hands, the number of wage-hand families would be reduced less than 20 per cent. This number would be needed for the hoeing and chopping. The yearly earnings per worker would be reduced about $80. At the prewar wage rates assumed, the total labor cost for the plantation would be about 60 per cent less, allowances being made for higher wages of picker operators. The investment in machinery would be trebled at the 1944 price of pickers. Machinery expenses would be increased about one half. The sales value per bale of lint would have been reduced about 17 per cent in 1944 by machine-picking and 7 per cent of the cotton would have been left in the field.

If this comparison had been made in terms of wage rates in 1944, however, the savings in labor would have been in the neighborhood of $13,000 rather than $6,500 and this would have compensated for the loss in crop receipts. What wages one can assume for the years just ahead can only be conjectured.

Wartime emphasis in the Delta was centered mainly around the production adjustments to meet labor shortages, and increases in the acreages of soybeans. The cotton acreage held up fairly well through 1943. Cotton yields reached all-time highs. In the portions of the Delta located in Mississippi, the total soybean acreage was less in 1943 and 1944 than in 1941, but a larger proportion was harvested for beans. Soybean yields ranged from 13 to 18 bushels in Delta counties in 1942.

THE ROLLING SANDLANDS While the boll weevil was doing its greatest damage in the eastern portion of the Cotton Belt, shortly after World War I, growers in the Rolling Sandlands in Area 14 in eastern Texas, in Louisiana, and southern Arkansas were expanding their acreage rapidly. In the last twenty years they have scaled down these acreages greatly. In 1933, they planted 4 million acres, 22 per cent less than at

the high point in 1925. In 1943, only 1.6 million acres were planted and the acreage in 1944 was still smaller. Yields are low, and they have not shown the recent increases of other areas.

TABLE 87. COMPARISONS FOR DELTA COTTON PLANTATION WITH AND WITHOUT THE MECHANICAL PICKERS OF 1944

Item	*Without picker*	*With picker*	*Net change with picker*
Machinery investment			
Pickers		$8,000	+ $8,000
Other	$4,200	4,200	0
Machinery expenses	2,400	3,500	+ 1,100
Defoliation cost		850	+ 850
No. wage families	23	19	− 4
Cost of hired labor	10,500	3,900	− 6,600
Receipts: cotton lint	28,400	21,900	− 6,500
cottonseed	5,800	5,400	− 400

Source: Calculations based upon data for picker operations in 1944. F. J. Welch and D. G. Miley, *Mechanization of the Cotton Harvest*, Mississippi Bull. 420, 1945 and *op. cit.*

For the most part the topography is rolling, the farms are small, and the fields are small and irregularly shaped. A great deal of one-row and half-row equipment is used. Cotton production practices are similar to those of the Coastal Plain. Farmers here have not used fertilizer as much as those in the Eastern states, and they have used relatively little tractor equipment thus far.

The soils in this area lend themselves to peanuts, which combine with cotton here in much the same way that they do on the Coastal Plain farms discussed in Bulloch County, Georgia, and Henry County, Alabama. Although the yields are lower, the costs are also lower because of the practice of raking the peanuts into windrows and threshing them rather than stacking them by hand for curing. This practice is made possible by the drier conditions with plenty of wind.

How large the farm incomes are in this area may be judged by Table 88. The cotton yields are around 150 pounds of lint per acre, and feed and livestock production rates are low. To support a family of four to six persons from such an income with prices at 1940 levels requires both ingenuity and a willingness to withstand the hardship of an extremely low level of living. The measures proposed for improvements on these farms — economical use of fertilizer, changes in farm organization, mechanization, and varietal changes — will hardly scratch the surface. Here as in the Piedmont, in the Clay Hills (Area 7), and in many parts

of the Coastal Plain, too many people are trying to make a living directly from land which is low in productivity. The cumulative effects of low incomes upon succeeding generations have created a problem beyond the usual boundaries of FARM MANAGEMENT. Good management will help, but there must also be improvements in health, in skills, and in opportunities "to get ahead," if desirable basic adjustments are to be made.

TABLE 88. VALUE OF FARM PRODUCTS SOLD, TRADED, OR USED BY FARM HOUSEHOLDS, PER FARM GROWING COTTON, SELECTED COUNTIES, ROLLING SAND LANDS AREA

County	*Farms reporting cotton*	*Crops*	*Livestock products*	*Forest products*	*Products used by household*	*Total*
Cass, Texas	3,898	$273	$54	$6	$186	$519
Vernon, Louisiana	1,251	143	77	3	252	475
Union, Arkansas	2,208	282	73	8	226	589

Source: Adapted from *Special Cotton Report*, 1940, Census of Agriculture.

THE OZARK-OUACHITA HIGHLANDS Cotton acreage and production have also declined rapidly in the past 15 years in the Arkansas-Oklahoma highlands (Area 12). The shifts have been to feed crops and pasture with increases in livestock numbers. This is a desirable long-time trend. Its future progress will depend upon cotton and livestock price relationships during the 1950's. There is still an appreciable unused capacity for producing roughages on farms here, and feed grains can be grown also. On the better farms in the area, however, cotton is by all odds still the major source of income, as it is in the near-by valleys of the Arkansas and Red Rivers.

THE HIGH PLAINS Cotton production on the High Plains (Area 22) has been discussed briefly in earlier chapters,[12] but it needs to be considered in more detail in order to bring out clearly the changes which go with mechanization of the cotton enterprise and to help us to understand how these farmers producing short-staple cotton, often of low quality, are able to compete with growers in other areas. One man is able to handle, with *the help of extra labor for hoeing and harvesting*, approximately 100 acres of cropland in this area with one set of single-row

[12] See Ch. XIII.

horse-drawn implements, or 180 acres with two-row horse-drawn implements. It has been estimated that the acreage which one man can handle can be increased to 250 with two-row tractor equipment, and to 450 acres with four-row equipment.[13] The tractor-mounted factory-built strippers came into extensive use during the 1944 harvest. A single-roller machine cost $695, the double-roller type, $1,195, and the finger-type, $695. These prices are similar to those for small and medium-sized combines. Mullins, in an analysis of their 1944 operations, estimates that three workers, including one to haul the cotton to the gin, can harvest as much cotton as 18 to 20 adults using hand-snapping methods.[14] A single-roller stripper and a three-man crew could therefore handle easily the 200 acres of cotton on a typical cotton system in the area before acreage control. This would mean the cotton of two typical farms; with acreage control, three typical cotton-livestock farms. Mullins estimates the costs of machine-stripping to be about one third of the total for hand-snapping at 1944 price-wage relationships. The workers received $1.75 to $2.00 per 100 pounds snapped during the season, compared with average rates of 50 cents per hundredweight during the period 1929–1936.

Other crops produced in the High Plains — corn and sorghum mainly — can be completely mechanized. Improved combines and varieties of grain sorghum suitable for combining have removed the last obstacle to machine-produced grain sorghum.

Obviously the pressure to increase the size of operating units in this area could be very great. With relatively high prices for cotton, the feed and livestock production would simply be fitted around the cotton enterprise in a secondary-supplementary relationship. The relative demand for cotton of different staple length will no doubt be a factor in the future. With low prices for cotton, this area might keep its production at a fairly high level while other areas would in time be forced into other lines of production.

COASTAL PRAIRIES In the Coastal Prairie[15] in Texas (Area 16) — more particularly in the Corpus Christi area — many farmers before 1933 planted more than 75 per cent of their cropland to cotton. The farms are large and the cotton is planted and cultivated with tractors. Itinerant workers do most of the picking. Uncertainties inherent in the

[13] A. C. Magee, C. A. Bonnen, and B. H. Thibodeaux, *Information Basic to Farm Adjustments in the High Plains Cotton Area of Texas*, Texas Bull. 652, 1944.

[14] *Op. cit.*

[15] See E. L. Langsford's *Changes in Cotton Production in War and Peace*, U.S.D.A Mimeograph, 1944.

use of migratory labor make growers in this area anxious to mechanize their cotton operations as soon as it is feasible to do so. The harvesting problems are more like those of the Delta than of the High Plains area. The dark rich soils produce sturdy plant growth.

UPLAND COTTON PRODUCTION ON IRRIGATED LANDS The areas in which upland cottons are grown on irrigated lands in California, Arizona, New Mexico, and El Paso County, Texas, are shown in Chart 117. In 1919, the plantings in these states totaled 275,000 acres, and at their peak in 1937, 1,125,000 acres. The average acreage in 1941–1943 was 750,000. Yields averaged 390 pounds in 1928–1932, and 474 pounds per acre in 1941–1943. This increase reflects the use of varieties better adapted to irrigation, improved irrigation methods, and shifts to better adapted sections within the irrigated areas. Thus far, irrigated cotton has been grown with very little fertilizer. Water requirements for growing cotton are less than those for alfalfa, and the cotton plants are better adapted than it to the poorer irrigated soils. This is particularly true for the lands with a high salt content. There is a rather wide divergence of opinion as to the future of cotton in these western irrigated areas. No doubt more irrigated land suitable for cotton will be made available—for example, in the Central Valley Project in the San Joaquin Valley in California. But some of this land may be in high demand for other uses.

FURTHER READING

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CHAPTER XXXVIII

Sugar and Specialty Crops

THIS CHAPTER IS INTENDED TO OUTLINE BRIEFLY SOME OF THE MAJOR management problems of several specialty crops grown in this country, particularly sugar cane and sugar beets, rice, and flax. It is assumed that soybeans and peanuts have been discussed sufficiently in the chapters on crop-and-livestock farming.

The emphasis will be on the problems that are more or less peculiar to these crops. Students of farm management in the states where these are grown will need to make the actual analyses of these problems, relying upon whatever studies have been made of them in their states or in similar states.

SUGAR CANE

Out of an estimated total production of around 35 million tons of raw sugar produced in the world, the United States produces around 2 million; Cuba around 4 million; India, 5 to 6 million; Java, 1 to 2 million; Germany, 3 to 4 million; and Puerto Rico, Hawaii, and the Philippine Islands, each around a million. And 23 out of the 35 million tons come from sugar cane mostly all grown on large subtropical plantations owned by white foreigners of Dutch, English, or American origin, often foreign capitalists, with the work performed for wages by the natives. Some of these plantations employ several thousand workers. They have been making much headway over the years in breeding improved and disease-resistant varieties and in improving their soil management practices, but much slower progress in laborsaving. Except in Hawaii, they pay their native laborers very low wages and supply them with cheap imported foods. On the sugar plantations of Puerto Rico, the diet consists mainly of rice, beans, and a small amount of salt codfish, all of which are imported. On the East Indies plantations the diets are largely rice. On most of these plantations, the seedbed is prepared with large-scale machinery, but from there on the work is largely

by hand: the planting, which is of joints of sugar-cane stalk, the hoeing, and the harvesting operations of stripping the leaves from the cane, and the cutting and loading of it on wagons or trucks for hauling to the factory.

Most European countries try to be nearly self-sufficing in sugar. The sugar industry is still very much subject to tariff duties, subsidies, and all sorts of government controls.

The United States census of 1940 reported 10,729 farms producing sugar cane for sugar. Only 8 of these were in Florida, but these 8 had one tenth of the total acreage. The rest are located in about 20 parishes (counties) in south central Louisiana, often referred to as the "Sugar Bowl." A fifth of the cropland in these parishes is in sugar cane and two fifths in corn, a fifth in cotton, and the rest in legumes grown in rotation or rice in some areas. Most of the corn is used as a feed crop. Under the cropping systems followed, some of the cultivated land may be idle. As much as a fifth was idle in 1936, but A A A crop controls were a factor in this.

The sugar-cane farms of Louisiana can be mostly put into three classes, family-size, middle-size, and large-scale. At the top in size are 2 per cent with 81 acres or more which have 60 per cent of all the sugar cane acreage in Louisiana. At the bottom are 77 per cent of them with 10 acres or less that have only 16 per cent of the acreage. In between is a small group of middle-size farms with 21 to 80 acres which have 14 per cent of the acreage.[1] In 1938 a survey was made of a group of 500 of the smaller of these sugar-cane farms, and the bulletin reporting the survey refers to them as "family-sized" farms.[2] But clearly many of them were larger than family-size as that term is ordinarily used, that is, a farm just large enough to be worked by the labor of an average farm family, with extra labor only for special operations like harvesting. These 500 farms hired on the average over twice as much labor as was supplied by the proprietor and members of his family. They averaged 41 acres of sugar cane and 45 acres of other crops. They are therefore dominantly middle-size sugar-cane farms.[3] A family-size farm in this area rarely grows more than 20 acres of sugar cane. The farms surveyed by Paul S. Williamson in 1941 averaged 44 acres.[4]

[1] Harold Hoffsommer, *The Sugar Cane Farm, A Social Study of Labor and Tenancy*, Louisiana Bull. 320, 1940.

[2] W. W. McPherson and J. N. Efferson, *A Farm Management and Cost Study on 500 Family-Sized Farms in the Louisiana Sugar Cane Area, 1938*, Louisiana Bull. 314, 1940.

[3] The report does not contain a table showing the range in size.

[4] Paul S. Williamson, *Economic Aspects of Sugar-cane Production in Louisiana, 1941*. Louisiana Mimeographed Circular 26, 1942.

MIDDLE-SIZE FARMS Since the available data more nearly fit the middle-size than the family-size farms, most of our discussion will relate to these. The 500 studied by McPherson and Efferson had, besides the 86 acres of land in cane and other crops, 8 acres of idle tillable land, 7 acres of tillable pasture, 11 acres of wooded and nontillable pasture, and 38 acres in woodland, farmstead and waste, making a total of 150 acres. About a third of the farms were full-rented, more largely on a share-rent basis, and some of the remainder were part-rented. The incomes of these farms in 1938 were $2,280 from sugar cane, $330 from other crops, $80 from livestock products, and $790 from A A A payments. The other crops sold were mostly truck crops. Corn is the principal other crop, but it is mostly fed to workstock and the livestock producing for use of the families.

Following is a list of the major management problems of these farms.

1. *The cropping system.* The typical rotation is one year in corn and soybeans followed by two years in cane. The land needs to rest for a year before it is replanted to cane. The cane comes up from the stubs of the old cane each year more or less indefinitely, but the yields decline. Williamson reported the following yields for 130 farms surveyed in 1941: plant cane, 21.6 tons; first-year stubble, 16.5 tons; second-year stubble, 15.7; older stubble, 14.7. All but 17 per cent of the cane was plant cane or first-year stubble. The soybeans are either plowed under or removed. Apparently they can be removed if the nitrogen is replaced by commercial fertilizer, at least in the short run. These farmers grew more cane and less corn and truck crops before A A A controls were instituted; but probably they did not get $790 of additional net income from their larger acreage. No budget analyses of the problem of the cropping system have been published.

2. *Fertilizer applications.* Williamson reported that no clear-cut information was available as to the effects of varying kinds or rates of fertilizer application. Most of the farmers apply small amounts of commercial fertilizer to plant cane — 130 pounds in the Williamson survey — and somewhat more to stubble cane.

3. *Varieties.* Much progress has been made in developing disease-resistant varieties of sugar cane since mosaic disease nearly wiped out the crop in 1923 to 1926. Over 60 per cent of the cane on the 130 farms was of a variety known as C.O. 290 developed at a breeding station in India and released only in 1933; a sixth of it of a variety — CP 29/230 — released from a U.S.D.A. breeding station in Florida in 1935; and

the rest of five other varieties. These vary in yield, sucrose content, earliness, soil adaptability, disease resistance, and habits of growth that affect harvesting costs. Data on yields by varieties under actual farming conditions are not generally available.

4. *Insect and disease control.* Roguing the cane to be used for planting stock is necessary to control disease. Only a third were doing this in 1941. Relatively few were applying the hot-water treatment to the plant cane to check a fungus disease called chlorotic streak, and few were dusting their cane fields to check cane borers. Failure to use any one of these controls may reduce yields from 10 to 20 per cent.[5]

5. *Drainage.* Providing adequate drainage is one of the major problems of a cane grower. The over-all drainage for this area is provided by drainage districts, of which Louisiana had 688 in 1941. Laterals from the ditches in these district systems reach back into the cane fields every hundred feet or so. (The average used in Williamson's analysis was 144 feet.) The cane rows are planted parallel to these. The ridges produced by cultivation improve the drainage in the rows, but they also keep the water from getting into the ditches after rain; hence "quarter-drains" are opened across the rows. These need to be cleaned out after cultivations. The laterals need to have the weeds and silt removed from them — that is, to be cleared and "grassed out." Failure to do this properly and on time means that the fields will be flooded after rains. The silt from the ditches makes the land higher near the ditches. Williamson presented data as to the frequency of performance of each of these operations, but none as to effects on yields. The range on opening quarter-drains was from 5 to 14 in 1941; and for grassing out, from 1 to 4.

6. *Equipment.* Of the 500 farms studied by McPherson and Efferson in 1938, only 85 owned tractors and 55 more hired some tractor work done. The costs charged to tractors on the 85 totaled $711 per farm — 750 hours work at 95 cents per hour. This was divided 64 per cent for growing and 36 per cent for harvesting. The report of this study gives virtually no other data that can be used in determining the economy of tractor use; the figure given for mule labor is an average for farms with and without tractors. Williamson found a much lower set of tractor costs — only $415 per farm on 101 out of the 453 farms surveyed, at a cost of 37 cents per hour. His mule-labor costs were for farms using only mule labor — 13 cents per hour. But he reported no figures for total

[5] Dusting has since come to be practiced generally on the larger plantations.

mule-labor costs on farms with tractors. Man-labor expenses are of course different on farms with and without tractors.

Cane loaders were used on 22 of the 453 farms surveyed in 1940. These farms averaged 137 acres of cane. These machines cost $1,400 in 1941. The cost of the machine per ton of cane loaded was only 4 cents. The man labor per ton of cane is reduced from 1.2 to 0.5 hours. Loaders have come into much wider use since 1940 on middle-size farms. Labor became scarce and wage rates rose from $1.25 per day in 1941 to $2.40 in 1944.

LARGE-SCALE FARMS A survey of 33 large-scale sugar-cane farms was made in 1937 and on these 33 and two more in 1938.[6] The 33 farms averaged 2,300 acres with 1,450 acres in cane. They represented an average investment of $258,000. Their gross income in 1937 was $123,000, including $27,000 of A A A payments. Their sales of other crops and of livestock products were around $4,000. Their cash outlays were $111,000. This left less than $5,000 of net income after an allowance for depreciation. The years following were no more prosperous on the average. Counting in depreciation, 60 per cent of the expenses were for labor, and 20 per cent for feed, fertilizers, seed cane, oil and gas, and other materials.

The survey was extended to 88, 90, and 76 farms, respectively, in 1939, 1940, and 1941.[7] This larger group averaged only 636 acres of cane. These 76 to 90 farms were owned by 36 to 40 individuals or companies. The farms in this group had not gone far in adopting labor-saving devices in 1939–1941. Labor was still abundant and cheap. Only a small fraction of them were using cane harvesters. Only part of them were burning the leaves from the cane in place of stripping them. At present, most of them are using these methods and a few are trying flame cultivation.

The plantations which operate mills undertake to fit together their custom grinding for the smaller farmers and the grinding of their own cane. They usually start in on their own cane around October 20, before it has attained its full sucrose content, and finish on their own cane late in December after the frosts may have caused some damage. Otherwise, the farm management problems are much the same for the large as for the middle-size farms except for more emphasis on management

[6] Roy A. Ballinger, *Financial Results of the Operation of Large Sugar Cane Farms in Louisiana, 1937 and 1938*, Louisiana Bull. 315, 1940.

[7] Roy A. Ballinger, *Financial Results of the Operation of Large Sugar Cane Farms in Louisiana, 1939, 1940, and 1941*, Louisiana Bull. 374, 1944.

of labor and equipment, and considerable expense for hired management. The cash outlays for labor were $49 per acre, as compared with $41 on the 500 middle-size farms reported above. If, however, the family and proprietor labor on the middle-size farms had been hired at the same rate as the hired labor, the cash outlays would have been $58 per acre. The yields averaged only slightly higher on these large farms as a group than on the middle-size farms. They were larger on the farms with less than 1,000 acres of cane than on those with 2,000 acres and over. There is a suggestion in this that management was becoming costly and less effective on the larger farms.

Here is an instance in which unit costs can be computed with relative ease, since all the labor is hired and virtually only one product is sold. The report of these surveys presents only averages of these farms by three or four groups according to acreage, output, and yield. These groupings reveal no significant differences. It is true that costs were somewhat lower on the farms with higher yields, but this does not demonstrate that any one of these farms could lower its costs by raising its yields. In general, the all-round best-organized farms will have the lowest costs and highest yields, and probably have the better lands. What these operators need to know is what ways of increasing yields on their particular farms will add more to receipts than to expenses. No doubt these farms differ considerably in efficiency of organization and in the use of labor and equipment, but this is concealed in the group averages.

GENERAL PROBLEMS Problems of national policy are even more pertinent in sugar-cane production than in wheat and cotton production. Sugar-cane growing has been heavily subsidized in this country by means of custom duties. The duty of 1.5 cents per pound on Cuban sugar in 1935–1939 was 35 per cent of the wholesale price of sugar,[8] and 28 per cent of the retail price. Under the Jones-Costigan Sugar Act, and later revisions, a limit was placed on the amount of sugar cane that could be grown without loss of A A A benefit payments, in return for which the sugar-cane growers received an average of 98 cents per ton per year in 1937–1939. The average price received for cane from the processor was $2.81. The growers received $1.22 of benefit payments in 1945, plus a subsidy of $1.60 from the Commodity Credit Corporation.

Under the Jones-Costigan and subsequent acts, the wages of hired labor are, in effect, fixed. In 1935–1939, they averaged $1.04 per nine-

[8] Cuban sugar paid only 80 per cent of the regular tariff duty of 1.9 cents, and that for Puerto Rico, Hawaii, and the Philippines, of course, paid no duty.

hour day for planting and cultivating labor, and $1.42 for harvesting labor.

In 1935, Saville and Dugas made a survey of the Sugar Bowl to determine how much more land could be devoted to sugar cane.[9] (Mosaic disease, the 1927 flood, and the depression of the 1930–1933 years had reduced the acreage greatly.) They concluded that the acreage could be about doubled, and that this would provide employment for 14,000 workers then on relief in the area. By 1944, the acreage had increased a fifth.

If wartime levels of farm wages are continued, the growing of sugar cane will need to be mechanized in large measure or further subsidies will be necessary. Also, the middle-size cane growers will need to expand their operations to the point where they can use cane loaders, cane harvesters, and other new laborsaving equipment; or depend upon custom hiring for these operations; or develop cooperative ownership of such equipment. How far the nation wants to go in subsidizing low-wage employment of labor on its farms in competition with the still cheaper labor of the Indies and South America, is a matter of public policy beyond the reaches of FARM MANAGEMENT.[10]

SUGAR BEETS

Optimum yields of sugar beets and high sugar content can be produced only where the climate is relatively cool with a large amount of sunshine during the growing season. In southern California, they are planted in the fall and early winter, make their growth before the hot summer temperatures, and are harvested in spring and early summer. Elsewhere in the United States, beets are planted in the spring and harvested in the fall. The sugar beets in our Western states are grown mostly on irrigated land. In the Lake and northern Corn Belt states they are grown without irrigation on some of the most productive soils found in these areas. Both in the West and in the Midwest the sugar beets are grown in a rotation with other crops on diversified family farms. The leading sugar-producing states in the West are Colorado, with around 170,000 acres before the war, and then California, Nebraska, Montana, Idaho, Wyoming, and Utah. In the Midwest, Michigan, with around 125,000 acres, has a larger acreage than Ohio, Wisconsin, Minnesota, North Dakota, and the other Midwest states combined. The yields in the irrigated valleys run around 12 to 13 tons per acre; in the

[9] R. J. Saville and A. L. Dugas, *Some Characteristics of Cultivatable Land in the Sugar Cane Area of Louisiana*, Louisiana Bull. 280, 1936.

[10] Harold Hoffsommer, *op cit.*

Midwest, around 8 to 9 tons. Sugar-beet acreage reached a peak in 1942, but shortages of labor and competition of other crops even more useful in wartime, such as potatoes and dry beans and peas, forced decreases in the later war years.

Most of the beets are grown on relatively small family farms employing not more than one or two regular hired hands at the most. The average acreage per farm growing sugar beets is about 20 acres in Colorado, 12 acres in Idaho, and 8 acres in Utah. In California, however, the average acreage per farm is about 85 acres, and in some of the leading counties is as high as 150 acres per farm. Considering the large amount of labor required per acre, these latter are really large-scale farms. The thinning and hoeing and harvesting of the beets has been done in the past with contract migrant labor. In Utah, the beet acreages tend to be smaller, and more of the work is done with local labor. A majority of the farms have cattle, sheep or dairy cows to utilize the beet tops and perhaps beet pulp along with other forage products on the farms. An 80-acre farm is likely to have 10 to 15 acres of sugar beets. In addition to the contract labor, which cost $20 to $25 per acre before the war, an acre of beets usually received 35 to 40 hours of regular farm labor, and twice that of horse labor, before the tractors came.

WESTERN VALLEYS The rotation systems which include sugar beets are highly varied. In Colorado, Utah, and the states adjoining, three years or more of alfalfa are commonly interspersed with the beets, with perhaps a grain crop in between to get rid of the alfalfa roots, and usually a grain crop to reestablish the alfalfa. But all sorts of other combinations are found along with these. In some areas, beans and peas are fitted into the beet sequences, or potatoes, or truck crops like onions, cucumbers, and melons, or red clover seed. The rotation may be as short as 5 years with one year of beets, or as long as 8 to 10 years with 3 years of beets. In California the commonest system is one in which barley hay is alternated with beets; but many of the farms also follow rotations with alfalfa and field beans.

Clearly, then, a major problem for such farms is the balancing of enterprises, which involves a complex set of factors. One of these is that the soil becomes infested with nematodes if beets are grown too often in succession. Another is that beets need soils high in humus and nitrogen, which can be supplied by growing and plowing under clover, alfalfa, and sweet clover as green-manure crops. Another is that the sugar-beet crop leaves the land in excellent tilth for potatoes, truck crops, beans, and the like.

Chart 118 shows the labor distribution on Colorado sugar-beet farms. Beets planted before April 15 have yielded 3 tons more per acre than those planted after May 15. Also, the longer the harvesting can be postponed, the higher the sugar content. Thinning needs to be done

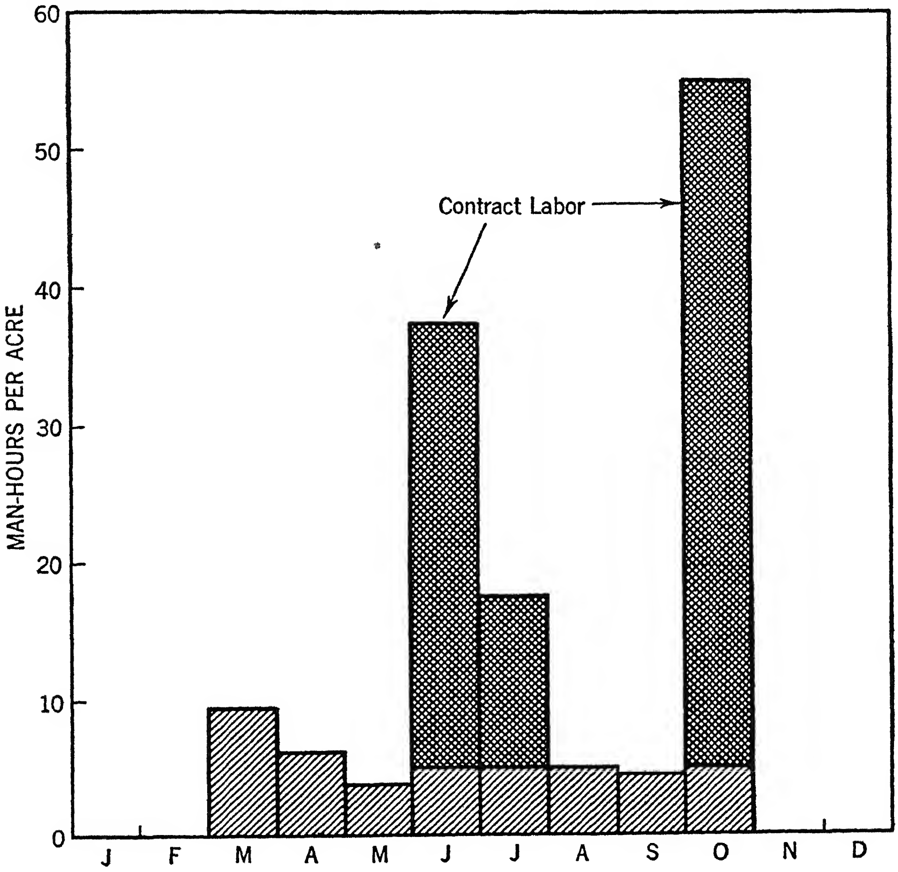

CHART 118. Distribution of man labor or sugar beets in Colorado (Based on Figures 1 and 2, U.S.D.A. Circular 488, *Developments in Mechanical Equipment in Sugar Beet Production.*)

before June 15. The more nearly the jobs are done at the right time, the higher the returns, but the heavier the peak loads of labor. A balance has to be struck between these two. The acreage of beets, of course, also determines the load at the peaks. If the regular farm labor force had to do all the work, the acreage would be greatly reduced. The use of migrant labor makes it possible to fit in other crops and have fairly steady work for the regular labor force. Other crops need to be such

that they can be fitted in with the beets, or like potatoes, they cut in on the beet acreage at harvest time.

Another very important factor in the western valleys is the market outlet for crops that can be fitted into the rotation. During the war, a guaranteed outlet for peas and beans at support prices caused more to be grown than in normal times. Alfalfa has high shipping costs; potatoes, onions, and melons likewise, and more uncertain outlets besides. But any one of these may add much more to the farm income than beets in some years. One can assemble data on the out-of-pocket expenses per acre of growing each of these crops, and pre-estimate the selling prices, and thus arrive at pre-estimated net cash incomes per acre for each. But one will by no means always increase net farm income by expanding the acreage of the crop that promises the highest net return per acre, and certainly will not do so by expanding it very far. Chapter XXXIX on "Irrigation Farming" contains a description of a typical farm setup including sugar beets, and analyses of some of the alternatives.

MICHIGAN The Michigan farms growing sugar beets are in the southeastern quarter of the state, and largely concentrated on the relatively flat heavy clay and loam soils of the Saginaw Valley. The group of farms surveyed by Wright in 1933–1936 averaged 150 acres of land, of which 115 were tillable.[11] Their cropping programs averaged 15 acres of sugar beets, 10 acres of beans, 22 acres of hay, 17 acres of corn, 31 acres of small grains, and 10 acres of miscellaneous crops. They averaged 10 cows and 2 sows. They planted their beets from May 10 to 15 mostly, which is after their small grains but before their corn. The beets sold for $860 per farm. One cannot tell from the report of Wright's study what cash outlays should be charged against this $860. Seed and fertilizer costs were about $5 per acre. The 209 farms that hired all the hand labor paid an average of $16 per acre for it. The farmers growing sugar beets kept less livestock. Their total income in 1937–1938, including A A A payments, was only $2 more per acre than that of the farms not growing sugar beets. This was just equal to the A A A payments.

The yields on these farms averaged 10 tons. The more successful sugar-beet growers obtained 13 tons. They were farming on the best soils in the best condition and used around 400 pounds of 2–12–6 or similar fertilizer per acre.

GENERAL PROBLEMS Beets, like cotton and other row crops, present the problem of density of stand. The optimum number of beets per

[11] K. T. Wright, *Sugar Beet Costs and Returns in Michigan*, Michigan Special Bull. 305, 1940.

acre depends both on the productivity of the soil and on the amount of moisture received during the growing season. In Colorado and Nebraska, best results are obtained in the irrigated valleys with 10- to 12-inch spacing of the beets in rows 18 or 20 inches wide; in Michigan, with rows spaced 22 inches. The problem of mechanical thinning of sugar beets seems to have been pretty well solved, but the new methods are only coming into use. The first step in this is breaking up the seed balls into segments, so that as many as five plants do not grow in one cluster. The latest development is making these segmented seeds into pellets with a coating of a plastic substance that checks decay. From this point on, a regular beet cultivator equipped with special knives will do a complete job of mechanical thinning. In one test in Colorado, the labor was reduced from 23.3 to 2.6 hours per acre; in another, from 27.2 to 2.5 hours per acre. The yields were not reduced in the least. Combinations of mechanical blocking and hand-hoeing use around 15 hours of labor before harvest.

Sugar-beet harvesting in the past has consisted of the following operations: (1) Lifting with a mechanical lifter drawn by a tractor or horses which breaks the tap root of the beet and lifts it partly out of the ground. (2) Pulling, a hand operation involving removing the loosened beets from the row and throwing them in convenient piles. (3) Topping, a hand operation with a sharp hooked knife separating the tops from the beets. This is a skilled operation, for if the crown is left on the beet, the mineral salts in the crown cause trouble for the sugar refiner, and any part of the beet itself left with the tops is lost for sugar making. (4) Hauling, the beets are usually hand-loaded and hauled by truck. If the sugar factory is a great distance from the farm, the beets will be hauled to a railroad siding and shipped to the factory by rail. (5) Hauling the beet tops to the feed lot. The average acre provides 3 to 4 tons of beet tops and crowns.

Mechanical harvesters came into wide use in some areas, especially in the Pacific states, during the war. They lift the beets, top them, shake off the clods of earth, and either pile them in windrows or load them directly into trucks.[12] Several types are in use, none fully developed. In California, 2 or 3 per cent of the beet acreage was harvested mechanically in 1943, 7 or 8 per cent in 1944, and about 33 per cent in 1945. Two-row machines can probably harvest 300 acres a year. They miss 6 to 9 per cent of the beets, leave more dirt on them than hand methods, and bury some of the tops in the ground so that livestock do not get them.

[12] E. M. Mervine and S. W. McBirney, *Developments in Mechanical Equipment and Methods in Sugar-Beet Production,* U.S.D.A. Circular 488, 1938.

They save most labor with high yields. To be used efficiently, they must be owned by the sugar company and rented to farmers, or operated by contractors, or owned by large farms. They present several problems yet to be fully solved, but are here to stay and will be used increasingly.

These mechanical innovations bid fair to reduce the labor inputs of sugar-beet growing to a level well below those of potatoes, their closest competing crop, in the Western Valleys and in Minnesota, and not greatly out of line with the labor inputs of corn and beans in Michigan. The crop will be much less dependent on Mexican and other migrant labor, and probably will tend to be fitted more into the regular farm work. How much it will need to be subsidized at recent levels of farm wages will depend upon the rate of adoption of laborsaving methods.

This country now grows its own sugar-beet seed by planting seed in July or August in southern California, Arizona, southern Utah, southern Nevada, and southern New Mexico, particularly, and leaving the beets in the ground over winter. The seed stalks sent up the following year are cut by an ordinary mower in August, and threshed with special thresher attachments. More than a million dollars' worth of seed of superior, disease-resistant strains have been grown in some recent years.

RICE

Rice farming, in contrast to sugar-cane and sugar-beet farming, developed in the United States without any significant tariff or other subsidy. It expanded until in the later war years this country became the principal supplier of rice to the United Nations outside the Pacific area. Of the non-Asiatic countries, Brazil now ranks first, the United States second, and Italy third. The use of machine methods of growing and harvesting rice, and of power machinery in developing the water systems, has enabled the rice producers of this country to compete with cheap Asiatic labor in the production of premium grades of long-grain rice in years of short crops in the Orient. It is doubtful if all the increased rice production developed in this country in recent years will be able to find remunerative export outlets.

The three rice-growing areas of the United States are along the Gulf Coast in Louisiana and East Texas, on some of the prairie or terrace soils of eastern Arkansas, and in the interior valleys of California. The Gulf Coast rice lands are mostly less than fifty feet above sea level. Rice growing needs a heavy stiff soil with a tight subsoil and with the water table fairly close to the surface.

The management problems of Southern rice farmers are pretty well

revealed by Hall's survey of 107 Arkansas rice farmers in 1927.[13] These farms are essentially cash-grain farms of the type found in the Dakotas. They differ from these in that they are irrigated, and the yields per acre are larger and much more certain. A majority of them a generation ago were operated by northern grain farmers who had migrated to the South bringing their grain binders with them. The 107 farms surveyed averaged 330 acres. Two thirds of the land was in crops, and four fifths of the cropland was in rice. The average farm had 162 acres of rice, which produced 8,200 bushels, which sold for $7,325 in 1927. Other farm receipts were only $265 per farm. Regular labor is hired on farms of average size, and extra day labor at harvest times. Next to $830 for hired labor, the largest expense on these farms was for fuel for the irrigation pumps, next for seed, and next for tractor fuel. The net cash returns in 1927 were around $4,000.

The outstanding management problem of these farms is, of course, the handling of the water. This is partly a technical problem of supplying enough but not too much water and at the right time, and partly one of efficient organization and operation of the water system. Next is the land management problem. The rotating of other crops with rice is needed, partly to build up the humus in the soil and improve its structure, and partly for weed control. The crops commonly grown are oats, lespedeza, and soybeans. Plowing under winter legumes, especially hairy vetch, is now recommended. All three Southern rice states have made studies of the application of commercial fertilizers to rice. The particular amounts applied in these trials generally increased yields significantly, but the results have differed considerably according to soils and condition of the land. The Louisiana rice experiment station at Crowley has developed the use in rice rotations of fertilized legume pastures as a way of building up a kind of organic nitrogen that is not leached out quickly by the water.

The most recent developments in rice farming are the use of combines and artificial drying to permit bulk handling and airplane seeding.

FLAX

Flax[14] competes as a cash-grain crop with wheat in the Dakotas, Montana, and Minnesota, and to some extent with other small grains, and recently it has been introduced as a winter crop alternative to

[13] Orville J. Hall, *Rice Farming in Arkansas with Financial Results for 1927*, Arkansas Bull. 260, 1931. Also suggestions were made by Professor O T. Osgood.

[14] This discussion is based considerably on T. H. Hopper and Muriel Johnson, *Flax Production and Climate of North Dakota and Minnesota 1919–1937*, North Dakota Bull. 298, 1941.

barley in irrigated land in California and Arizona. Historically, it has been a crop grown on new land until the soil has become infested with flax wilt or weeds. Its seeded acreage declined from 1912 to 1922 even though new land was being brought into use, increased sharply in 1923–1925 and then declined to 1938. The 1937–1938 acreage was only around 30 per cent of that of 1924–1925 and 1910–1912. This decline occurred in spite of tariff duties of 65 cents per bushel. This country imports more flaxseed from Argentina than it produces. The increase after the last war was largely the result of a campaign to substitute flax for the wheat that was glutting the world's markets in 1921–1923. The Department of Agriculture and the state agricultural colleges in these states struggled hard with this surplus problem and about the only concrete suggestion which they came forth with was to grow more flax.

Flax is an even more uncertain crop than spring wheat on the Great Plains. Yields per harvested acre in North Dakota fluctuated from 2.7 to 8.4 bushels between 1919 and 1937; and in Minnesota, from 4.9 to 11.4. The yields per seeded acreage would show a much wider range. The Division of Crop and Livestock Estimates collected estimates from its field reporters from 1910 to 1927 as to the causes of yields below a "par" or maximum of 12 bushels per acre. The reductions below par in North Dakota ranged from 15 per cent in 1916 to 72 per cent in 1910, with an average of 36 per cent over the period. Of this 36 per cent, 20 was attributed to drouth, 4 to hot winds, 4 to frosts, 2 to hail, 4 to diseases, and 3 to grasshoppers and cutworms. Drouths and high temperatures, especially in July, reduced not only the yields, but also the amount and quality of the oil in the seeds.

The North Dakota Experiment Station recommends the growing of flax only on land that is cultivated enough to destroy most of the weed seeds, and where the rainfall averages at least 20 inches, or possibly 18 inches if cultural practices are followed that conserve the moisture effectively. Flax in this region must therefore be looked upon only as a crop that can be fitted into the crop rotations of some farms in some years. Rarely should it replace feed crops. The farmers in flax territory need to watch the relative prices of wheat and flax, combine these with the yields of the two crops which they have learned to expect in these fields, and substitute flax for a fraction of the wheat acreage, on land that is ready for flax, in those years in which it promises the largest net cash returns per acre. The acreage expanded rapidly in 1939–1940 when wheat acreage was restricted, and then doubled from 1940 to 1944 under wartime price supports. Yields were good in these years also — around 9 bushels.

Where flax is grown in the Salt River Valley of Arizona and in the Imperial and San Joaquin Valleys of California, the summer temperatures are too high for flax, but the winter temperatures are quite satisfactory. The winter rainfall in the San Joaquin Valley will nearly but not quite grow a crop of flax. One irrigation of perhaps 6 inches, or perhaps two totaling about 10 inches, will give yields of around 20 bushels per acre. The acreage of this type of flax reached 323,000 acres during the war, and the production was as high as 12 per cent of the national total. In California, the flax acreage is likely to decrease when the price of a bushel of flax is less than the price of 170 pounds of barley, and to increase when higher. Farms growing flax under these conditions are likely to grow cotton in the summer.

BROOMCORN

Until well along in the last century, broomcorn was grown near to centers of population in the East and Midwest, and as far south as the border states, and worked up into brooms in small factories or shops located in most of the cities. As late as 1900, occasional farmers in the Midwest grew broomcorn to supply these local broom-makers. They had learned how to grow broomcorn from their ancestors who had grown it farther East. Now most of the broomcorn is grown in the Southwest, over half of it in Oklahoma. The only center east of the Mississippi is in a few counties centered around Coles and Cumberland in east central Illinois.

The varieties grown in the East, and for that matter mostly in the central Oklahoma district, grow from 8 to 15 feet tall and are known as Standard. They have to be broken over, or "tabled" before the tops can be cut off. In the area around Woodward in western Oklahoma are grown the Dwarf varieties, whose heads can be pulled.[15] Broomcorn is much more resistant to drouth than corn; especially the Dwarf varieties. It tends to be grown on the lighter soils and needs dry weather at harvest time. For best results, the heads should be threshed on the same day as gathered, and the brush placed on shelves in a special curing shed. In western Oklahoma, however, much of it is cured outdoors in ricks. The particular management problems of broomcorn growing are as follows:

A. Getting an even stand. In the Woodward area, if the plants are more than 6 or 7 inches apart, the brush is too coarse; if less, it is too fine

[15] A special type of Dwarf, known as Japanese Whisk, has shorter heads and finer fibers.

or stemmy for good yields. A complication is that broomcorn seed, like other sorghum seeds, tends to germinate poorly.

B. Keeping the varieties pure and free from disease. Not only do the varieties cross readily, but broomcorn also crosses with the grain sorghums, and forage and even Sudan grass. The larger growers have their own seed plots and rogue for purity of type and freedom from disease. The seeds need to be treated to prevent smut.

C. Keeping the weeds down while the plants are making their slow early growth.

D. Harvesting just at the right time and proper threshing, curing, and sorting.

E. Marketing. As common with minor specialty crops, the markets may not be well developed, and may be subject to manipulation. Cooperative marketing has made some progress in this field.

F. Keeping production adjusted to the market. The demand is highly inelastic, and the growers tend to alternate with overplanting and low prices and underplanting with high prices.

OTHER SPECIALTY CROPS

Dry field peas, except for seed, are mostly grown in one area, the Palouse area of Washington-Idaho mentioned in Chapter XVIII. The growers had expanded their acreages to the limit of the market before the war, and then quadrupled them in 1943–1944 under high support prices.

Dry beans, in contrast, are grown on a wide range of territory. The largest acreages are of the navy or pea beans grown in the Saginaw Bay area of Michigan and in western New York; the lima, Red Kidneys, and blackeyes of California; the pintos of the high, cool, semiarid plateaus of Colorado and New Mexico; and the Great Northerns of the western irrigated valleys. About all of these except the limas and pintos fit into the crop-and-livestock farming systems discussed in Chapters XIV and XV. The pintos are a high-risk crop like wheat handled by machine almost entirely. The limas in California are grown largely in the dry season on sloping fields on reserve supplies of moisture. The support prices during the war were double prewar prices, but acreages increased scarcely a half.

In 1900, over 200,000 farms in the United States grew buckwheat; in 1940, only 57,000. The acreage, however, declined only 55 per cent. These figures partly indicate the place of buckwheat in the agricultural economy of the Eastern states. At one time, most farming areas in the

East grew enough buckwheat to meet local demands, a few farmers planting it as a second crop on an old hayfield. At present, it is grown in much the same way, but only on occasional farms in New York and Pennsylvania; and to a lesser extent in the Piedmont areas of the Virginias. Consumption has declined because of competition with prepared pancake flours that may or may not include buckwheat.

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CHAPTER XXXIX

Irrigation Farming

THE PURPOSE OF THIS CHAPTER IS TO DISCUSS THE SPECIAL PROBLEMS of management that arise on farms because they are irrigated. In 1940, the census reported nearly 300,000 irrigated farms. Nearly all of these were in the eleven states from Montana to Texas and westward. On one fourth of these 300,000 farms, however, only the cropland was irrigated. The largest other blocks of irrigated farms were the rice farms of Arkansas and Louisiana, needing irrigation only because of their large water requirements. The special Census of Irrigation in 1939 reported only 21 million acres of irrigated land. This is only 2 per cent of the farm land of the United States and only 7 per cent of the cropland. But irrigated land is so much more productive than ordinary farm land that 54 per cent of the cash income of all the farms on the eleven western states, according to Table 89, came from the irrigated land, counting 35 per cent of the income of the partly irrigated farms as having come from the irrigated part of them, mostly in the form of feed for livestock. The total cash income of $723,000,000 income thus derived was 9 per cent of the cash income of all farms in the United States in that year.

For crops considered by themselves, the irrigated land produced 72 per cent of the cash income of the eleven states. Most of the remaining income was from wheat. For livestock, the comparable figures are only 22 per cent — this from dairy cattle mostly. The range cattle and sheep of these states figure largely in the totals.

California has three times as many irrigated farms as any other state. Idaho comes next, then Colorado, and then Utah. But in percentage of farms irrigated, Nevada leads with 91 per cent, followed by Utah, Idaho, California, Colorado, and Arizona.

Although irrigation has been practiced in this country for a hundred years, most of it has developed since 1890. The census data indicate that the area irrigated was perhaps 4 million acres in 1890, 8 million in 1900, 14.4 million in 1910, 19.2 million in 1920, and 19.5 million in 1930. Much of the early development was simple diversion from flowing

TABLE 89. ELEVEN WESTERN STATES: CASH FARM INCOME BY GROUPS OF COMMODITIES, 1939, AND ESTIMATED ORIGIN BY IRRIGATED, PARTLY IRRIGATED,[a] AND NONIRRIGATED PRODUCTION

Commodity group	*Total*	*Cash income ($1,000)*		
		Wholly irrigated	*Partly irrigated*	*Non-irrigated*
Crops: Total	710,300	514,700		195,500
Food grains	110,900	7,800		103,000
Feed grains and hay	58,800	35,000		23,800
Cotton lint and seed	50,500	50,500		0
Flaxseed	3,800	3,000		800
Total vegetables	178,200	154,200		24,100
Potatoes	34,100	31,200		2,900
Truck crops	119,600	107,900		11,800
Other vegetables	24,500	15,100		9,400
Total fruit	211,700	186,700		25,000
Apples	29,000	25,600		3,400
Peaches	15,100	14,300		822
Pears	13,500	11,700		1,700
Grapes	30,800	25,700		5,000
Strawberries	7,000	4,000		3,100
Citrus	73,800	73,800		0
Other fruit	42,500	31,600		10,900
Other crops	96,400	77,500		18,900
Livestock and livestock products: total	645,800	144,800	183,000 (35)	318,100
Wool	38,600	600	12,500 (30)	25,400
Dairy products	176,700	70,600	29,400 (68)	76,700
Eggs	56,900	11,900	4,700 (50)	40,300
Chickens	15,500	4,300	1,200 (50)	10,000
Turkeys	19,900	4,400	11,100 (50)	4,400
Cattle and calves	218,200	25,200	95,700 (29)	97,300
Hogs	37,800	16,200	3,000 (50)	18,600
Sheep and lambs	82,200	11,600	25,400 (31)	45,300
Total cash farm income	1,356,100	659,500	183,000 (35)	513,600

Source: Derived from publications and releases of the Bureau of Agricultural Economics showing cash income by sources: Agricultural Census, 1940, and the judgment of persons familiar with the agriculture in these states. The assistance of Carl P. Heisig and Wendell Calhoun is acknowledged.

[a] The figures in parentheses are the portion of this income attributable to irrigation.

streams, without storage. The simplest diversions were made first, often by individual ranchers or farmers or by small groups of them. Later, more difficult and expensive works, serving larger areas, were constructed. These involved more formal organization, such as the irrigation

districts. The earliest diverters usually secured the first water rights; later diverters were able to get water only after the earlier rights were satisfied. In order to have water during the dry season, storage dams were built. As the more expensive projects were built, private capital was hesitant to promote additional developments, and public construction was undertaken. At first this was state, but later it was federal. Concurrently, irrigation development by pumping was developed.

Of the 21.0 million acres now irrigated, 16.0 million receive their water supply from streams, 13 million acres of this by simple gravity diversion, and the other 3 million acres more or less by pumping. About 2.5 million acres obtain their water supply from wells, mostly by pumping. California has 60 per cent of the pump irrigation. In 1939, water was actually applied to only 17.4 million acres. The projects commonly have less water than is needed for all the land they were designed to serve.

IRRIGATION ORGANIZATION

The Census of Irrigation distinguishes the following major types of irrigation enterprises:

1. *Individual and partnership enterprises* belonging to individual farmers or neighboring farmers who control them without formal organization.
2. *Cooperative or mutual enterprises* controlled by the water-users. They may or may not be incorporated. The most common form of organization is the mutual water company in which the shares of stock are in proportion to the water assigned to the users.
3. *Irrigation districts*, which are public corporations established under state laws which empower them to issue bonds and to levy and collect taxes. These irrigation districts are controlled by the owners of the lands comprising them.
4. *Commercial enterprises* which sell water to farmers. These enterprises are subject to some degree of public control in most states.
5. *The U. S. Bureau of Reclamation enterprises*, which are federally owned and constructed. These may provide either primary or supplementary water. Their operation and maintenance may be transferred to a local water-users' organization.

Table 90 shows that about one third of the irrigated area gets its primary supply from individual and partnership enterprises, and another third from cooperative enterprises. Federal projects included less than 10 per cent of the area receiving a primary supply, but nearly half of the area securing a supplemental supply. The early private and cooperative

developments were obviously much less costly than the later district and reclamation projects. Future irrigation development is likely to be very largely federal.

TABLE 90 IRRIGATED ACREAGE AND INVESTMENT, 1940, BY TYPE OF IRRIGATION ENTERPRISE

Type of enterprise	*Primary source of supply — million acres*	*Supplemental supply — million acres*	*Investment — million dollars*	*Investment per acre — dollars* [a]
Individual and partnership	7.31	.60	188	24
Cooperative	6.65	.86	224	30
Irrigation district	3.51	.21	266	71
Commercial	1.02	.13	66	57
Bureau of Reclamation	1.82	1.46	250	76
Other	.68	.03	58	82
Total	21.00	3.29	1,052	50

[a] Based on area of primary and supplemental supply.

KINDS OF IRRIGATED FARMS

Irrigation is a method of producing crops, not a type of farming; hence, the irrigated farms are of many types — dairy, crop-specialty, fruit, livestock, general, etc. The irrigated land in the 300,000 irrigated farms was used as follows: hay, over half alfalfa, and the rest mostly wild hay, 38 per cent; grains, including corn, sorghum, oats, barley, flax, wheat, and rice, 25 per cent; specialty crops, including potatoes, cotton, sugar, beans, and peas, 14 per cent; orchard and vineyard, 8 per cent; and irrigated pasture, 16 per cent. The 1930 census of agriculture does not show the number of irrigated farms of each type. The 1940 census shows the number of irrigated farms, but does not classify them according to type. The following is an approximate classification obtained by fitting together the 1930 and 1940 census figures:

1. *Hay-producing* farms, which may or may not have livestock. These include, besides the irrigated farms specializing in alfalfa hay, all the ranches with irrigated cropland, and also some hay-producing farms in the ranching areas and elsewhere which may temporarily have no livestock or which may not ordinarily have any livestock. Probably 40,000 to 45,000 are in this class.
2. *Fruit and vegetable* farms, of the types described in Chapters XL and XLI following, but irrigated. Probably 65,000 to 75,000 of these.

3. *Special cash-crop* farms, growing cotton, potatoes, sugar beets, and beans mainly. These farms may grow some alfalfa for sale, or may have some fruits and vegetables, or may have some livestock, but only as minor enterprises. They tend to be rather highly specialized and localized. Probably 35,000 to 45,000 of these.
4. *Dairy* farms, like dairy farms elsewhere except that their chief source of feed is the irrigated crops. Alfalfa is a staple crop in nearly every western irrigated area, and it is fed to dairy cows, often with no grain supplement, in many Western dairy areas. Probably 35,000 to 45,000 farms of this type.
5. *General* irrigated farms. These, like general farms elsewhere, grow several crops and keep one or more kinds of livestock. The general farms in the irrigated areas almost always include alfalfa and dairy cows. Perhaps 40,000 to 50,000 of these farms.

We shall be able to visualize the management problems of irrigation farming better if we stop and examine one of them. A *general* farm of the sort found in the more northern valleys will serve this purpose as well as any. The particular farm chosen is on the federal Minindoka Irrigation Project in southern Idaho. The soil is sandy, and was subject to blowing when first irrigated. It is only moderately fertile. This area has been farmed less than 40 years. The farm has 76 acres, of which nearly 69 acres are in crops. The acreages of the crops have averaged over the past several years as follows: alfalfa, 31.5 acres; small grain, 10.5; irrigated pasture, 7.7; cash field crops (potatoes, sugar beets, beans, etc.) 18.0; miscellaneous, 1.0; and total, 68.7. The cropping sequence is usually small grain as a nurse crop, alfalfa for 3 to 5 years, and cash field crops for 2 years. The irrigated pasture is rotated among the fields, each field remaining in pasture several years at a time. Small acreages of carrot, onion, and lettuce seed are grown.

Normally this farm carries 6 dairy cows, with young stock for replacements, 2 brood sows, 20 sheep, 50 laying hens, and 4 horses for work animals. The milk is sold as butterfat to a local creamery. The cows average about 240 pounds of butterfat. Practically no feed is purchased; the cows are fed alfalfa, except when on pasture, and receive no grain. The grain produced is largely fed to the hogs and chickens. The sheep and work horses get their feed from pasture during the pasture season and hay at other seasons except that the horses receive a little grain during the summer. The supply of hay and grain is somewhat more than is required for this livestock, and a little is usually sold.

The operator of this farm, a middle-aged, active man, does all of the farm work except for an extra hand during haying and other har-

vesting, and for contract labor for the sugar-beet thinning, weeding, and harvesting, and the potato picking. He worked in a normal year recently the equivalent of 263 ten-hour days; and members of his family, including the wife and a growing son, the equivalent of 75 ten-hour days, in caring for the chickens, in washing of dairy equipment, and in helping with other farm work on occasion. The equivalent of 62 ten-hour days of labor was hired, in addition to the contract labor.

OPERATING STATEMENT, 1940

Receipts			*Expenditures*	
Crops		$1537	Labor	$206
Hay, grain, and pasture	$248		Threshing, etc.	76
Cash crops, including seeds	1289		Feed and seed	170
			Fertilizer, other crop	103
Livestock		1182	Livestock (purchases, etc.)	66
Dairy products and cattle	528		Repairs	112
Lambs and wool	225		Gas and oil	45
Hogs	365		Insurance, electricity, etc.	54
Poultry and eggs	64		Irrigation water costs	178
			Taxes	102
A A A payments (mostly for sugar beets)		324	Miscellaneous	31
Total cash		$3043	*Total cash expense*	$1143

Net cash income	$1900
Less depreciation of machinery buildings, etc.	230
Net Business Gain	$1670

This is essentially a one-man farm, with a diversified cropping and livestock program, somewhat more intensive than most farms of 80 acres in the Midwest. The alfalfa yields about three tons per acre, and requires considerable labor. Converted to butterfat, lamb, and wool, it represents a rather high output per acre. Sugar beets, potatoes, onions, beans, and seeds require much more labor, and return a gross income per acre over twice as large. Too large an acreage of these latter crops would mean a heavy drain on the land. Budget analysis reveals that too small an acreage of them, however, means less employment on the farm and reduced income. The plowing, seeding, cultivating, and other field operations on the cash crops provide work on many days during the growing season when the alfalfa needs no attention.

Budget analysis also shows that the livestock operations are well adjusted to the feed supply and to each other. During the six-month pasture season, the cattle and sheep get their feed solely from pasture

except for a little hay for brief periods, and sugar-beet tops for a few weeks. In the other months, they are fed fully on hay. Total digestible nutrients in alfalfa were valued in this area at less than 1 cent per pound in the prewar years; in grains, at about 1.5 cents per pound. The alfalfa is high in quality, and good dairy cows will produce 250 to 300 pounds of butterfat on alfalfa and pasture alone. The hogs receive pasture in the summer, skim milk throughout the year, and grain, the amount depending on their age. The chickens utilize waste and by-product feeds such as skim milk and grain screenings.

The livestock enterprise can be adjusted upward or downward in intensity and in numbers, depending very largely upon the family labor supply. All the hay and grain raised on the farm may be fed out; or some may be sold, or some bought, and the number of livestock adjusted accordingly. Small farm flocks of sheep return about as much per hour of labor and per unit of feed as dairy cows because they use feed that would otherwise be wasted. Medium and larger flocks do almost as well. However, a dairy cow and her replacement young stock provides about 140 hours of productive employment annually, whereas five ewes and their lambs (which would use about as much feed) provide but 40 hours of productive employment annually. Substitution of hogs for dairy cattle leaves net farm income and labor requirements about unchanged as long as the number of hogs does not exceed the number which can receive a full ration of skim milk. Skim milk is a cheap feed in this area, and when combined with pasture and limited grain, makes for cheap hogs. If the number of hogs is increased too far, and farm grain production increased proportionately, budget analysis shows that the dairy income is lowered more than the income from hogs increases.

The farming system must, of course, be carefully adapted to the water supply on the half of the irrigated acreage where the water supply is deficient by varying degrees, from only slight deficiency, the chief effect of which is to reduce yields of late-season crops somewhat, to a supply that adds very little to the rainfall. The season of water shortage is nearly always late summer — August and September, and perhaps late July as well. Crops like potatoes and sugar beets cannot be grown at all under such conditions, and the yield of alfalfa and irrigated pasture may be reduced so sharply as to make them uneconomical. Small grains and corn can often be grown with good yields where alfalfa cannot. The crop best adapted to an uncertain and highly variable water supply, however, is wild hay. It will stand flood in the spring high water, and late summer drying out. The water supply is often inadequate on small streams where no storage has been developed. These small streams are

often located in ranching areas, where the hay supplements the grazing on the ranges.

WATER SUPPLY PROBLEMS

One group of problems connected with the operation of irrigated farms relates to access to water. Needless to state, an irrigation farmer's right to water is extremely important. Western history is replete with instances of failures of land developments because they were based on faulty water rights. Water rights are now more accurately known than in former decades, but disputes still occur. Many rights, though known, have limited value, because applying only to flood waters or for other reasons. If the farm has a "full" water right, one that provides adequate water for the entire growing season, it can grow a far greater variety of crops than if it has water only during the season of flood waters.

An extensive body of law has grown up in the Western states on the subject of water rights. Only a few remarks can be made about it here. In general, the body of law on water rights comes from two major sources — Spain and England. Spanish law was developed to deal with the use of water in an arid climate. It was introduced into the Southwest and California by way of Mexico. It has become the basis of water rights in most Western states. Under it, one "appropriates" water for private use, upon approval of some state official, and upon the basis of an application which usually requires proof that the water is to be put to beneficial use. The date of application establishes priority in use of water, and early priorities must be fully satisfied before later priorities can secure any water. "The first in time is the first in right." Prior to establishment of state water codes which set forth this procedure, rights became established by actual use of water and were often confirmed by court action.

English law, in contrast, was developed to deal with use of water in a humid climate. A major feature of it was the *riparian* doctrine, under which the owner of land along a stream has an inherent right to use of the water in it, but he must not pollute the water nor diminish it for other riparian owners. Strictly interpreted, this doctrine would make irrigation impossible. Riparian rights cannot be lost by non-use, nor impaired by establishment of priorities. An attempt was made to establish this doctrine in the West; it has been wholly repudiated, in favor of appropriation, in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming, and almost wholly repudiated in Oregon. In the other two Pacific Coast states, and in the Plains states from North

Dakota to Texas, the riparian doctrine has been greatly modified, but by varying degrees in the different states.

The above discussion applies to surface water. Where underground water is in definite channels or streams, it is subject to the same laws. Usually, however, the water is more diffused and is known as *percolating* water. This includes that water that is drawn upon in pump irrigation. Laws with respect to such waters are diverse — in some states, they are subject to appropriation; in others, they belong to the owner of the overlying land, perhaps with a restriction that the water be reasonably used, perhaps without such restriction.

Equally important is the price which a farmer has to pay for the use of water. On the Idaho farm analyzed above, the water charges were only $2.40 per acre of cropland. On many projects, they run higher than this. When irrigation works are first constructed, usually some kind of an analysis is made as to the charges which they will impose, and as to whether the land will be made enough more productive to carry these costs. But miscalculations have sometimes been made. Or they may not have been miscalculations in the long run, but prove to be such if an agricultural depression strikes while the project is still young. A common mistake has been the failure to include drainage costs.

As indicated above, much of the irrigation development in the West has been by landowners or their organizations. In such case, the water is provided at cost, and any surplus income becomes capitalized into higher land values. When water is provided by a commercial enterprise, the price of water is often well below what it would sell for on an open freely competitive market. The market is one in which the farmer on the land has the bargaining advantage. The water cannot ordinarily be transferred elsewhere and sold. In practice, the owners of water, whether private or public, have been at a disadvantage in the West. The terms of their contracts seem to give the owners or lenders a preferred position, but the contracts are not easily enforced. If the farmers are unable to pay their water charges in a series of bad years, the owner of the water or of the irrigation bonds can of course refuse to supply water, but what will he do with it then? About his only alternative is to foreclose on the land, but he must then be prepared to operate it and to resell it. Few suppliers of irrigation water have found it wise to pursue a strict policy. Irrigation district bonds have repeatedly gone delinquent in the West, but the bondholders have not foreclosed on the land. Repayment of costs on federal irrigation projects have been subject to frequent moratoria, yet in no instance has the federal government taken possession of the land irrigated by its works. Under these circum-

Irrigation farming, of course, greatly improves the soils at the start, by adding humus to them and improving their tilth, moisture penetration and moisture-holding capacity, and supplies of nitrogen. If the irrigation is skillfully handled, it can mean perfect soil-moisture relations at all times and indefinitely. But such an ideal is not commonly realized. In the West, much irrigated land has received such excessive applications of water that already large areas have been seriously damaged, even utterly ruined. Apparently reasoning that "if a little is good, more is better," many irrigation farmers have seriously injured their own farms and those of their neighbors by excessive application of water. Frequently, a major part of the water applied is lost, either in the form of surface runoff or excess groundwater.

Irrigation water can also be applied in such a way as to cause severe erosion. A running stream of water, such as is part of every irrigation system, may have great erosive power. If water is run directly down bare slopes, severe erosion is inevitable; or if too large a stream is used, even though the slope is moderate. On the other hand, enough water must be used to irrigate the soil at the end of the row adequately, without seriously "overirrigating" the first part of the row. A well-designed irrigation system considers slope of the land, soil type, and the length of row or "run" of the water. Once such a system has been designed and installed, the size of the stream and the length of each irrigation period are under control of the irrigator.

Considerable irrigation water is also lost from absorption into the soil directly from the ditches. In time, more of the permanent ditches will be lined with concrete, not only to save water and keep it from becoming injurious groundwater, but also to give better control of the water. Some irrigation systems are poorly designed; water flows too fast or too slowly, with the result that earth dams must be built for each irrigation, and constant watch kept to prevent washing of soil due to break-through or overflows in the system. In contrast, a well-designed system has permanent headgates, usually concrete, proper slope in the canals for exactly the right movement of water, and can be "set" to distribute water safely without supervision for many hours. In California and elsewhere, underground cement pipe is commonly used to carry irrigation water, and complete control over the flow of water is possible.

The frequency of irrigation depends on the depth of soil, its ability to retain moisture, the water requirement of the crop, and the temperature and humidity of the air. The amount of labor required per irrigation depends upon the slope of the land, the character of the soil, the

size of the irrigation stream, the amount of water applied, and particularly upon the layout and efficiency of the irrigation system. Water must be applied slowly to sloping land. Sandy land will absorb water rapidly; level sandy soil can be flooded and the water will quickly move into the soil. Heavy soils will not absorb water rapidly, and more time is required to irrigate them. If the irrigation stream is small, as is often the case with small systems, much labor will be required to irrigate a given area of land. If a relatively large amount of water is applied, more labor is required per irrigation than if a small amount of water is applied; but the labor per season will be less if relatively large applications are made. Most researchers now believe that relatively large applications of water, as long as the amount of water applied does not exceed the capacity of the soil to absorb it and keep it within root range, are more efficient in terms of labor required and equally efficient in use of water.

With due allowance for all of these factors, the time required usually falls somewhere within the following wide ranges:

	MAN-HOURS PER ACRE PER SEASON	NUMBER OF IRRIGATIONS
Alfalfa	6–10	4–8
Small grain	3–5	2–4
Potatoes	10–15	6–10
Sugar beets	6–12	4–8

The foregoing discussion should give the reader a high respect for the familiar figure in an irrigated area of the man with the long-handled shovel over his shoulder walking the ditch banks. Upon his skill in directing the water to the growing crops depends not only the yield of the crops, but how economically the water is utilized, and the future condition of the soil. Many farmers acquire such skill. Some are able to judge the moisture condition of the soil from the appearance of the plant. When plant wilting is evident to the novice, the soil moisture has already fallen too low. More dependable methods involve actual sampling of the soil at lower depths and judgments based on the appearance of the soil at these depths.

Irrigation brings complications in the use of machinery. Water cannot be distributed efficiently if the ditches are too far apart. The length of the "run" depends on the slope and the soil type; generally it will not exceed 660 feet, or an eighth of a mile, and may be as short as 220 feet. Runs are commonly of lengths that will divide a mile evenly. If the ditches are permanent structures, this limits the size of fields for

plowing, cultivating, and other field operations. Temporary ditches permit plowing and preparation of the land over larger fields, but call for extra work each year in making the ditches. The concrete pipes used in California, and to a limited extent elsewhere, are buried below plow depth, and the occasional vertical pipes which bring the water to the surface, to be distributed through small temporary ditches, do not interfere much with plowing and cultivating.

Irrigation probably requires more group action than any other type of farming. Except for the simple diversions from small streams and for pumping, irrigation water is usually obtained for several farms as a unit. Likewise, where drainage is necessary, seldom is it possible for a single farmer to install a drainage system for his land only. Irrigation water also carries weed seeds from one farm to another. As a result, weed control requires the cooperation of groups of farmers, either formally in weed control districts or informally. Group action having become habitual, cooperative marketing and other related activities tend to arise in irrigated areas.

PROBLEMS OF PARTICULAR AREAS

This general discussion of problems of irrigation farming will be more meaningful if supplemented by a brief discussion of the problem of a few areas.

THE YAKIMA PROJECT, WASHINGTON [1] On the Sunnyside Division of the project, a multiplicity of irrigation and drainage districts cause much confusion and wasted effort. Also, several kinds of water rights have developed because parts of the area were developed at different times. The water charges vary greatly in consequence. Some form of redistribution of the construction costs is needed. The farming needs to be intensified on the better lands and extensified, by shifts to livestock on larger acreages, on the poorer lands, and by improving the pastures. The apple production of this area is already weighing too heavily on the markets.

On the Indian Reservation part of this project — only about 11 per cent of the farmers are Indians — 54 per cent of the land is rented under insecure tenures, with the result that the land is being farmed destructively. A group of 171 farms average only 16 acres of irrigated land, and part-time off-the-farm employment is scarce. The area needs to shift to more livestock and to plowing under more green-manure crops, to

[1] Based on Washington Bulls. 428 and 430, *Economic Conditions and Problems of Agriculture in the Yakima Valley* by Wallace McMartin and by Alden E. Orr, 1943.

raise the humus content of the formerly arid soils. Water is being very wastefully used at present. Weeds are becoming rampant, partly because of so much tenancy. Only by group effort directed toward destroying the weeds on the ditch banks and roads can the weeds be kept under control.

MONTANA PROJECTS [2] P. L. Slagsvold and associates studied five of Montana's irrigation projects in 1936–1937. They found that the farmers were growing too many cash crops and not enough leguminous and soil-conserving crops to maintain the soils, and that too much erosion and leaching and seepage was being permitted. Dairying in the Bitterroot Valley, and livestock fattening in the Yellowstone area, were keeping up the soils much better than the cash-grain farming of the Sun River area. Slagsvold proposed a fifty-fifty division between row- and close-grown crops, with livestock to convert the feed crops into barnyard manure. Yields need to be increased by better soil management. Poor construction of irrigation ditches, and weeds, are also serious problems. Half the land is rented on the Flathead and Huntley projects.

BIG HORN COUNTY, WYOMING [3] The farms in this area depend upon cash crops mainly — beans and sugar beets in about equal proportions. Alfalfa is the forage crop. The grain crops, oats, barley and wheat, occupy a fourth of the 61 average crop acres. Sheep and dairy cows provide a fourth of the farm receipts. The adjustments needed are more livestock to use up waste feed and provide more manure for the land, better adjustment of crops to the type of soil, and better crop rotations. Lack of good drainage is making some of the land alkaline.

UTAH The extent of damage to irrigated soils from long abuse is illustrated by reports from Utah. Two unpublished soil reports on two areas in Utah contain the following information: If only deep alluvial soils are considered, 12,300 acres in Uinta Basin and about 9,000 acres in Salt Lake County have become at least partly waterlogged as a result of irrigation. This represents about 7.5 per cent of the deep alluvial soils in the two areas. While much of this land is still being farmed, deep-rooted crops like alfalfa usually fail. Many of these soils could be readily reclaimed by drainage, but some are saturated with soluble salts and are so poorly adapted to drainage that it is doubtful whether reclamation would be practicable.

[2] Based on Montana Bulls. 342, 350, and 357, P. L. Slagsvold, H. H. Lord and J. D. Mathews.

[3] Wyoming Bull. 205, A. F. Vass and Harry Pearson, *Economic Studies of Irrigated Farms in Big Horn County*, 1935.

The extent of erosion in irrigation is apparent by a drive through the agricultural lands of Utah. At the side of every highway, soil accumulation can be seen at the bottom of fields raising the land level one, two, or even four feet above the fields below. This change has been so gradual that farmers are hardly aware of it. Many farmers have remarked, however, that crop yields are much better at the lower ends of their fields, and an analysis of soil samples showed that the lower ends of fields contained 20 per cent more nitrogen and 30 per cent more organic matter than the upper ends. Analysis of soil samples from adjoining fence rows showed no significant difference in composition at the upper and lower ends of the fields.[4]

A survey of the Uinta Basin in Utah showed that much of the water is being applied to the wrong land. A sixth of the land receiving water was classed as not suitable for crops, and three times this amount of arable land has only a secondary water supply.[5] A study of efficiency of water use showed much lowered efficiency resulting from applying too much water at one time, applying water either too fast or too slow, applying water while the soil is still moist, accumulation of the water in low places, excess runoff, and obsolete irrigation systems.[6]

NEBRASKA PUMP IRRIGATION IN THE PLATTE VALLEY.[7] These farms use pump irrigation to supplement the uncertain rainfall of central Nebraska, and in consequence are able to grow a combination of corn, sugar beets, and potatoes as cash crops. Only a fifth of the income is from livestock. Little alfalfa is grown. The forage grown is mostly sold to farmers on adjoining nonirrigated land. The farms studied averaged 90 acres of irrigated land and 110 of nonirrigated. The main management problems are deciding how much water to apply and when, keeping up the fertility of the land, and balance of enterprises. Yields are often reduced because not enough water is pumped, especially on the rented farms. Under existing leases, the landlords do not bear their share of the pumping expense. Sweet clover is commonly plowed under as a green-manure crop, but this will not be sufficient in the longer runs.

ARIZONA The irrigation problem in some parts of Arizona — and also New Mexico, for that matter — is that pumping has been carried

[4] D. W. Thorne and D. A. Anderson, "Irrigation and Permanent Agriculture," *Yearbook of the Association of Pacific Coast Geographers*, 1942, Vol. 8.

[5] George T. Blanch and Clyde E. Stewart, *Utilization of Irrigable Land in the Reservation Area of Uinta Basin, Utah* Utah Bull 303, 1943

[6] Orson W. Israelsen, Wayne D. Criddle, Dean K. Fuhriman, and Vaugh E. Hansen, *Water-Application Efficiencies in Irrigation.* Utah Bull. 311, 1944

[7] Arthur W. Peterson, *A Farm Management Survey of Pump Irrigated Farms in Buffalo County*, Nebraska Bull. 358, 1944.

to the point that the groundwater level has been very greatly lowered. "It is not advantageous to the state, from the standpoint of public welfare, when a supply of groundwater already in use in one community, is seized upon for use in another, leaving the people in the first community cheated, with the loss of their investments, and any such transference of water rights should be guarded against." [8] Attempts to exercise needed control have thus far largely failed in Arizona.[9]

In the Salt River Valley the main problem appears to be too much concentration on Pima and Upland cotton and on wheat for the longer-run good of the area. More alfalfa and hegari sorghum, and feeding these to cattle, will distribute the labor load better and give a better balanced agriculture.[10] The desert soils are very high in mineral nutrients, but need more organic matter.

IRRIGATED PASTURES Trials in Oregon show that irrigated ladino clover or ladino and grass pasture will maintain two cows per acre with a 15 to 25 per cent grain supplement. An acre of such pasture produces the equivalent of 4.4 tons of alfalfa hay, or 190 bushels of oats. Fertilization increased the yields by 75 per cent.[11] California trials indicate a carrying capacity of two cows per acre for the bulk of the acreage of such pasture in the state, for a grazing season of 8 to 11 months. It was providing cheaper feed than any grain, and probably alfalfa hay also.[12]

FUTURE DEVELOPMENT IN IRRIGATION

The three major lines of development in irrigation are salvaging and better management of lands already under irrigation, supplying more water to land now inadequately supplied, and bringing new land under irrigation. The first of these may be as important as the other two. Irrigated land has been going out of crop use at an alarming rate in the past fifteen years. Part of the land never should have been irrigated; even a superficial examination of it would have shown that its soils could not be converted from desert to irrigated types, because of their impervious hardpans or for other reasons. Some of this land can be

[8] Based on: G. E. P. Smith, *Groundwater Law in Arizona and Neighboring States*, Arizona Technical Bull. 65, 1936; and G. E. P. Smith, *The Groundwater Supply of the Eloy District in Pinal County, Arizona*, Arizona Tech. Bull. 87, 1940.

[9] New Mexico, Utah, and Idaho now have groundwater laws.

[10] R. L. Matlock and S P. Clark, *Production Costs and Returns from Major Salt River Valley Field Crops, 1928–1930*, Arizona Bull. 146, 1934.

[11] H. P Ewalt and I. R. Jones, *The Value of Irrigated Pastures for Dairy Cattle*, Oregon Bull. 366, 1939.

[12] Burle J. Jones and J. B. Brown, *Irrigated Pastures in California*, California Circular 125, 1942.

reclaimed by drainage. But still more important is to prevent the waterlogging and salinizing of that which need not suffer this fate. The mistakes made in applying water to land need not be repeated in new areas. The soils can be carefully mapped and the water conserved to cover as large an acreage as possible of land without hardpan and otherwise suitable for irrigation, and the irrigation system can be laid out so as not to contribute to the abuse of the land.

Of the new projects, the Columbia Basin Project in Washington will ultimately bring something over a million acres into irrigated crops. About a third of this is now "dry-farmed" for wheat production, and the rest is only low-grade grazing. The Mountain Home Project in southern Idaho will be like the Columbia Basin one as far as soils, climate, and types of farming are concerned.

In the Central Valley Project in California, the essential problem is the transfer of water from the Sacramento Valley, where there is more water than needed, to the San Joaquin Valley, where the water supply is seriously deficient. The presently authorized project was about half completed by early 1946; extensions are planned which will ultimately increase the irrigated area as much as 3 million acres. Much of the water from early units of the project will be used to replenish the depleted groundwater supply. Water costs in this area are and will be high, judged by most of the western irrigated area. But the favorable climate and good soils make possible an intensive type of farming with heavy emphasis upon fruits and vegetables. Markets may not absorb this additional surplus, however, and this may force some general farming and livestock. Somewhat similar, as regards climate, soils, and adaptability to intensive crop farming, are proposed irrigation developments in central Arizona.

Another major type of irrigation development is that proposed for the Missouri Valley and for the Willamette Valley in Oregon. In each case, farming without irrigation has been carried on for many years. Irrigation will make possible a shift to more intensive farming. By no means is all the land, especially in the Missouri Valley, suited to irrigation. The irrigation costs will be high. The simple, easy irrigation developments have all long since been made. Those left are either expensive in relation to benefits, or large and difficult, or both. Many of the future developments will involve irrigation on slopes and benches where erosion, cropping, fertility maintenance, and other problems will arise. The larger projects will all be multiple purpose, involving flood control, hydroelectric power generation, and other features to some degree, as well as irrigation. Moreover, the day has definitely passed when water

development in one part of a stream basin can proceed without reference to water use in other parts of the same basin. Basin-wide planning, and ultimately basin-wide operation, are required. It is these considerations which have led to plans for Missouri Valley and other "authorities," which could undertake unified development of the water resources in a watershed.

FURTHER READING

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*G. E. P. Smith, A. F. Kinnison, and A. G. Carns, *Irrigation Investigations in Young Grapefruit Orchards on the Yuma Mesa*, Arizona Tech. Bull. 37, 1931.

*United States Department of the Interior, Bureau of Reclamation, *Columbia Basin Joint Investigations, Types of Farming*, Problem 2, 1945.

CHAPTER XL

Fruit and Nut Farming[1]

THE 1940 CENSUS PRESENTS DATA ON THIRTY SPECIES OF ORCHARD fruits, ranging from apples, peaches, and oranges at the top of the list, to quinces, pomegranates, and kumquats at the bottom; on ten species of berry fruit, from strawberries, raspberries, and cranberries at the top, to currants and gooseberries at the bottom; and also on grapes of all descriptions, and pineapples. The nine species of nuts listed include principally pecans, almonds, and walnuts. Obviously this chapter cannot deal with the special management problems of all these varied types of fruit and nut production. Instead, it will analyze briefly some of the problems that are common to all of them, and then single out one orchard fruit and one small fruit for somewhat more detailed examination.

The major difference between the species from the standpoint of management is in their life-span. As made very specific in Chapter XXXIII, a fruit tree ordinarily does not come into bearing for a few years after it is planted; its yields at first are low, then rise to a crest and continue at that level for a period, then decline until the tree dies or is removed. Peach trees, the shortest-lived of the common fruit trees, usually last at least 10 to 15 years and often much longer. Apple trees are ordinarily kept in commercial production for 30 to 50 years; citrus fruits and walnuts, 50 or more; and some olive trees in the Mediterranean region are believed to be over a thousand years old. Grapevines may live many years, but probably average 30 to 40 years at removal. Tree-fruit and nut growing are truly long-range enterprises; and each tree goes through a life cycle resembling that of man. At the other extreme, strawberry plantings give one or two crops only, and raspberries ordinarily not more than six or eight.

Roughly 2 per cent of all farms in the United States were fruit or

[1] J. R. Magness of the Bureau of Plant Industry made several suggestions for improving this chapter.

nut farms in 1930 and 1940.[2] Only 1 per cent of the cropland harvested was in such farms, but the value of their land and buildings was 5 per cent of the United States total, and the value of products produced on them 4 per cent of the total. There were, however, 55 type-of-farming areas and subareas in 1930 in which fruit farms were the dominant type. Fruit production tends to be concentrated in many small areas. Many of these are too small to include even in this list of 55.

Many farms have small backyard orchards and grow grapes and strawberries and other small fruits for the use of the family. But the numbers of these probably have been decreasing in recent years, partly because fresh fruit is now more available in the stores and farmers get to town more often, and partly because disease and insect control have become more difficult. Also, no doubt, oranges and bananas have been substituted in a large way for apples and pears in farm family diets. The percentage of farms reporting apples, pears, cherries, plums, and peaches has fallen off around a fourth since 1910. The percentages of small fruits increased until 1920 and have declined since, a fifth for raspberries and strawberries, to four fifths or more for currants and gooseberries.

LOCALIZATION

The fruit-growing areas of this country are mostly located around its edges, on the Pacific Coast, along the Gulf and Atlantic Coasts, and around the Great Lakes. The interior areas are in the Rocky Mountains, Ohio Valley, and Ozark Highlands mostly. Nearly half — 45 per cent — of the fruit farms of the country were in the Pacific region in 1940, and 35 per cent in California alone. These 35 per cent, moreover, produced 43 per cent of the fruit. Florida had 9 per cent of the fruit farms, and produced 9 per cent of the fruit. Washington ranked third, New York fourth, and Michigan and Oregon next.

Climate, it is apparent from the foregoing, is the major factor determining localization of fruit growing, and winter temperatures and frost hazard are the most important factors in climate. Citrus fruits will not stand temperatures below freezing even for a few days; and the deciduous fruits will sustain cold only at various levels below zero. Walnuts and figs are intermediate. Late spring frosts may destroy the crop while in the blossom stage. The western shore of Lake Michigan produces fruit which the eastern shore of Wisconsin cannot because the prevailing westerly winds off the Lake retard the blossoming in the spring until

[2] In addition to the 134,000 classified as fruit or nut farms there were 535,000 which received an average of $80 from the sale of fruit and nuts.

after the danger of frost is passed. Good air drainage makes fruit growing possible, not by retarding spring growth, but by preventing the late frosts. Some locations capable of producing fair yields of fruit do not permit production of the highest-quality fruit. Climatic requirements are more exacting for fruit than for any other major agricultural commodity grown in the United States. Some of the best apple-growing areas have cool summer nights and warm sunny days, which help to keep the codling moth in check and make more highly colored apples. Raisin growing is dependent on good drying weather at harvest time. Soil and other production conditions are important for high-quality fruit, but ordinarily are less of a factor in determining location than climatic factors.

CALIFORNIA Almost half of the nation's fruit is grown in California and is distributed in the very diverse pattern shown on Chart 119. The greatest concentrations are in the Santa Clara Valley south of San Francisco Bay, in the lower and central Sacramento Valley, in the central San Joaquin Valley, and in the Los Angeles area. Grapes are distributed widely over California, but varieties and uses are localized considerably. The intensive area in Fresno County and surrounding territory grows mostly Thompson Seedless for raisins, but also produces much wine and ships fresh grapes. In the San Joaquin Valley, near Lodi, is a highly specialized area which ships fresh Tokay grapes. Sonoma County mostly grows wine grapes.

In the citrus areas in the southern part of the state, lemons are grown mostly in Ventura County and other areas near the Coast. Oranges are produced in large volume in Orange, and the western parts of Riverside, San Bernardino, and Los Angeles Counties. The foothills section of Tulare County also grows oranges well. Walnuts are grown on sites with colder winters as far north as Washington. Santa Clara County is the great prune-growing center. Peaches are found in many locations, but are most important in the lower Sacramento Valley and its foothills. Sutter County is perhaps best known for peaches. The foothills along the eastern side of the Sacramento Valley present a combination of grapes and pears, peaches, and plums. Lake County is best known for its pears.

The foregoing account gives too much the impression of full specialization by sizable areas. Actually the patterns may be much more varied. There may be a sharp break between different fruits or nuts within a small range. Oranges are sensitive to temperatures, and at the time when most oranges were planted in southern California they were able to

command the choicest sites. They are therefore planted near the tops of the hills, where air-drainage is best, but not on the very tops where they would be exposed to winds. More "smudging" against frosts is necessary as one goes down the slope. Walnuts begin where the oranges

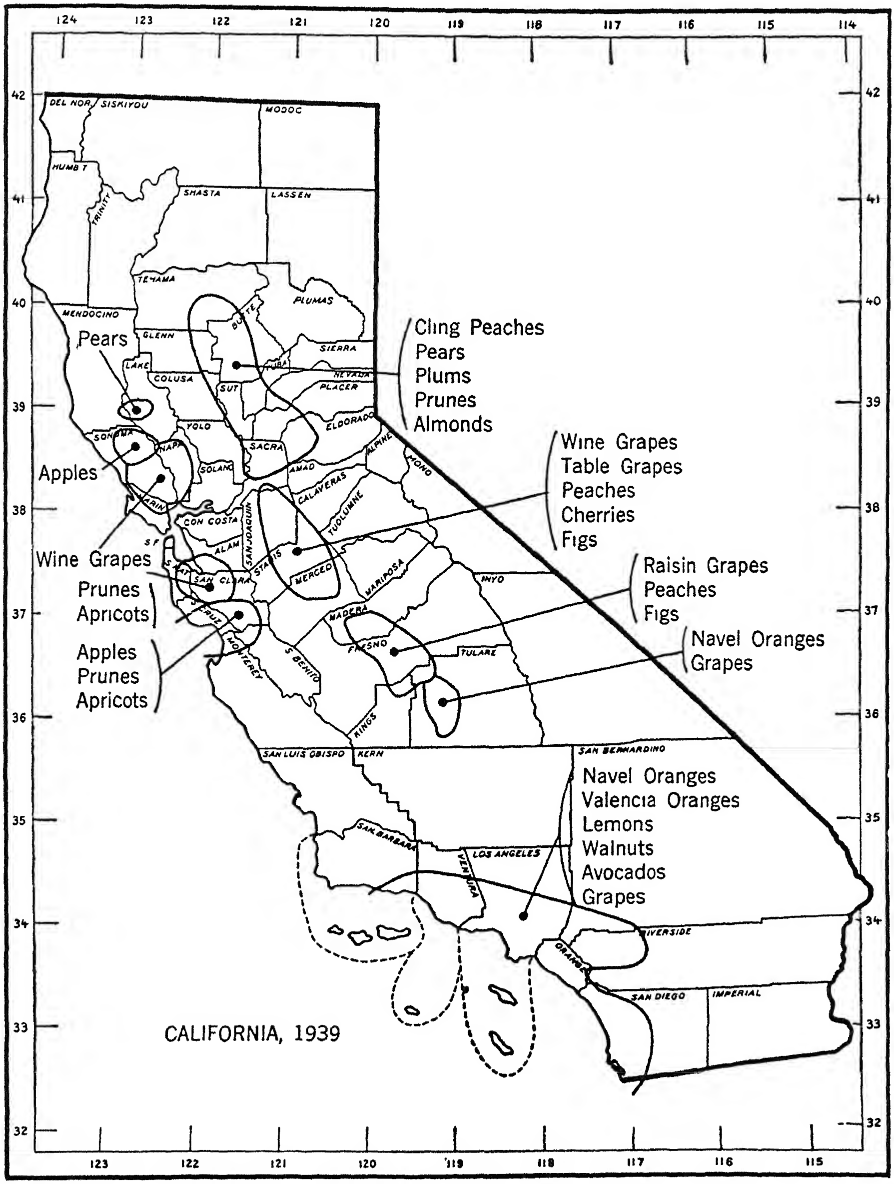

CHART 119. The distribution of fruit growing in California.

stop. Where the winters are too cold for walnuts, alfalfa or other "open" crops appear.

When the oranges were planted, avocados were comparatively unknown even in California. The avocado is more exacting in its climatic requirements than the orange, and in recent years has probably been able to out-compete the orange for the best sites. Were the area all to be planted over again today, avocados probably might occupy a somewhat more important place in this area.

ELSEWHERE IN THE WEST In the Pacific Northwest, the orchard areas are rather highly specialized, under the influences of climatic factors of frost, cool summer nights, and good exposure to sun. Apples are the leading fruit in each area, but pears, peaches, apricots, or cherries may be grown on the same farms as the apples, or on separate farms, the apples taking the cooler sites generally because pest control is costly on the lower levels. The Yakima area has the widest variety of fruits, and the Hood River area the least. The Tieton Plateau and the Selah Heights near Yakima are heavily specialized in apples and pears, whereas the lower Yakima Valley has more peaches, apricots, and cherries.

The Puget Sound area of Washington specializes in raspberries and blackberries particularly, but also grows strawberries. Clark County specializes in prunes and strawberries, especially the first. The northern Willamette Valley of Oregon grows berries of all kinds, prunes and other common fruits, and also filberts and walnuts.

The fruit areas in southern Idaho, northern Utah, western Montana, and western Colorado are much like the apple areas of Washington and Oregon in their general emphasis upon apples, but they also grow peaches, cherries, apricots, and pears.

The Arizona areas grow oranges and grapefruits, but seem somewhat better adapted to the latter. They, like California, are handicapped by the long distance to major eastern markets.

THE SOUTH Orange production began in Florida at an early period, nearly as early as in California. Many plantings were made on poor sites and in areas too far north, with heavy losses when the inevitable freezes came. In the last two decades, the plantings have generally been on good sites. Florida occupies a dominant position in grapefruit production, and large expansion in output is in prospect as the young trees mature and heavy plantings continue. High-quality fruit can be put on the large Eastern urban markets cheaply; in the prewar years, much fruit moved by boat. Orange production in Florida has also come forward rapidly and now equals or exceeds that of California. Many

young trees have yet to come into full bearing, and plantings are continuing heavy.

Oranges and grapefruit have had an even more disastrous history in southern Texas, but this seems to be a low-cost area, and production will surely expand in the near future unless further severe frosts strike soon. The other southern fruit areas are principally the peach area of central Georgia, the highly specialized strawberry areas of eastern Louisiana and the Ozarks, and the apple area of the Shenandoah Valley of the Virginias and Maryland. The Ozark section is diversified among apples, peaches, grapes, and strawberries. The farms are largely family operated, with very little hired labor, in sharp contrast with fruit farms in most other areas. The strawberry farms in eastern Louisiana are also of the family type, averaging only about 9 acres in crops, and 3 or 4 acres of strawberries. The Shenandoah Valley specializes largely in apples, but the orchards are widely dispersed, not compactly centered as in the West.

THE NORTH The points of concentration for fruit growing in the North are the grapes, apples, cherries, and pears in western New York; grapes and apples along the shores of Lake Erie; the grapes, peaches, pears, and strawberries of southwestern Michigan; and cherries in the Traverse Bay section of Michigan and across the lake in Door County, Wisconsin; the peach and apple section in southern Illinois; the peaches and strawberries of Delaware and the Eastern Shore of Maryland; the cranberries of Massachusetts, New Jersey, and Wisconsin; and the blueberries of Maine and New Jersey. Some of these fruits are on highly specialized farms — the cranberries, for example; but others are grown in combinations of two or three fruits, or with dairy farming.

FRUIT FARMS IN GENERAL

In spite of their wide difference in type of products, fruit farms have much in common. First of all, they utilize but little land. The largest average acreage found in the 28 counties studied for the purpose of this chapter, and chosen to represent conditions in all important fruit areas, was 75 acres of cropland in Frederick County, Virginia. The fruit farms in 10 of these counties averaged less than 25 crop acres, the lowest being the berry farms in Pierce County, Washington, which averaged 6 acres of cropland.

Second, fruit farms have a high investment per acre. This is particularly true of farms growing tree fruits or nuts. Individual orange groves

in prime condition in southern California sold for more than $3,000 per acre in the latter 1920's. In the depression of the 1930's the same groves sold for $1,500 or less if at all. Then during World War II, they climbed to perhaps $4,000 an acre. Similarly, good bearing apple orchards near Yakima, Washington, sold as high as $2,000 per acre in World War I, gradually declined to as low as $350 to $500 per acre in the late 1930's and rose again in World War II to $1,000 and even $1,500. Fruit farms in the East and the Lake states are priced much lower because they usually contain much land not in fruit and have lower yields.

Third, specialized fruit farms usually have very little livestock — ordinarily nothing more than a dairy cow or two, a horse or two, and a few chickens. Many have nothing but workstock and buy all the feed for this.

Fourth, fruit farms, even small ones, hire relatively large amounts of labor. In most of the 28 fruit-farming counties studied, expenditures for hired labor exceeded one fourth of the gross farm income. Even the small strawberry farms of Louisiana and of the Ozarks spent $200 on picking labor. More typical farms are the following, chosen from counties in which the average gross farm income was still relatively small:

	GROSS FARM INCOME	EXPENDITURE FOR LABOR
Pierce County, Washington	$1,840	$ 510
Hood River County, Oregon	3,370	910
Santa Clara County, California	3,850	1,030
Fresno County, California	2,700	900
Hidalgo County, Texas	1,830	740
Lake County, Florida	1,830	540

When fruit is ready to harvest, it needs a great deal of hand labor for a short time. A farm that a family can handle the rest of the year may need a dozen helpers at harvest time. The harvest season may be as short as ten days, and except for citrus fruit rarely lasts a month for any one kind of fruit. Spraying, pruning, and thinning also may require extra labor. All of the harvest and other peak labor is hand labor, with very little prospect of ultimate mechanization. The nearest approaches to mechanization are the towers mounted on trucks occasionally used for picking fruit on large trees, and the mechanical shakers used with nut trees which shake the nuts onto canvas. Fruit picking is almost always paid for on a piecework basis. The worker's output is easily measured and checked for quality.

OPERATION OF A TYPICAL ORCHARD FARM

We shall comprehend better the management problems of fruit farms if we review in brief the operations on a pair of actual farms. The apple farm in the Yakima area of Washington described following will cover this purpose for deciduous orchard fruits; and citrus fruit farms resemble these in their general organization. This farm is located on sloping land above the valley floor, not on the top of one of the ridges and plateaus found in this area. It has 25 acres, of which 19 acres are in orchard, and the rest is used for farmstead, a small pasture, and an acre of alfalfa. The farmer has made three major apple plantings, of which the following trees remain:

1914 Winesaps, 240; Jonathan, 120; and Rome Beauty, 120.
1922 Winesaps, 120; Common Delicious, 240.
1928 Common Delicious, 60; Red Delicious, 60.

These plantings portray well the history of the area — a wave of planting prior to World War I, another wave shortly after that war, and smaller plantings in the late 1920's. Few trees have been planted since 1930. The popular varieties have changed also; the Rome Beauty and Jonathan have declined in favor, and the Delicious and Red Delicious have risen in popular esteem. This farm also has some other fruit trees. Of the Bartlett pears now standing, 40 were planted in 1941, 80 in 1922, and 60 in 1928. The 110 cherry trees still standing were all planted in 1924. Each of the apple plantings was interplanted with peaches, which were removed when the apples began to bear heavily. The last peach trees from the 1928 apple plantings were removed very recently. The farm is thus fairly well diversified as to kinds of fruit and also as to varieties of apples. The 1,230 fruit trees on the farm average 65 trees per acre in orchard.

All of the cash income of this farm is from fruit. This farmer keeps a cow and chickens for home use and usually raises a pig or two for farm slaughter, and has a good garden. The work on this farm has the following seasonal pattern: In the winter, there is nothing much but pruning, which can be stretched over the long dormant season, and the application of the dormant spray to kill scale. In the spring, the calyx spray must be applied when the trees are in blossom, and there is the irrigating to tend to. In mid-June to early July, the cherries are harvested and the apples need thinning. Both of these operations need hired labor. For the frequent sprayings throughout the summer, this farm has a fixed pump with pressure pipes extending through the orchard. Spraying is

ordinarily a two-man job, so that a helper must be hired unless work can be exchanged with a neighbor. The spray must cover the apples, leaves, and branches thoroughly. A fine mist fills the air and settles over the men as well as the trees. By fall, the trees and apples are a dull gray from the spray residues. This is removed from the apples by washing with chemical solutions in the packing sheds before they go to market.

The peak of labor begins in September. The picking season lasts only a week or so for any variety. On this farm, a few apples are ready to pick before September 15, and the harvest must be practically completed by November 1st. The bulk of the picking is largely concentrated in the last week of September and the first week of October. This means that a picking crew must be engaged, supervised, and kept busy. The apples must be placed in storage promptly — preferably within 24 hours — and the temperature lowered.

At average prewar prices, the cash expenses of this farm were about $3,000, or $158 per acre in orchard. About half of the cash costs were for labor, most of this for picking. The spray materials cost about $600. Taxes were $100, and irrigation water cost $67. Perhaps $500 should be added for depreciation of buildings, equipment, and upkeep.

The fruit trees on this farm are nearly all mature and few of them have passed their prime; hence, yields are at a maximum. Such trees average perhaps 450 packed boxes per acre. Our typical farm produces about 7,200 packed boxes of apples on the average, excluding those sorted out in the packing shed for worm damage or for other reasons. Not only the number of boxes, but also the grade of apples varies from year to year. These differences, plus the wide variations in prices, make it extremely difficult to estimate a "normal" gross farm income. The farm price of enough apples to make a packed box has varied from as low as 10 cents or less to over $1.25. Under normal prewar cost conditions and average yields in this area, it took about 29 cents per box to cover the cash costs, and 7 cents per box more to cover depreciation and the like. Prices in the 1920's were generally enough above this latter figure to cover these costs and leave a good return to the farmer for his management and labor and for his investment. During the 1930's, however, farm prices were below 36 cents a box in five of the years, and 29 cents in three of the years. In 1937, farm prices were 15 cents per box.

ORCHARD MANAGEMENT PROBLEMS

Let us now consider briefly the ordinary run of managerial questions that face the operator of orchards such as the one just described.

SIZE OF BUSINESS It is as possible to have too small an orchard as it is too few acres of cotton. Over half of the fruit farms in the Yakima Valley have less than 10 acres in fruit, and four fifths have less than 20 acres. The minimum equipment for such an orchard will handle 20 acres, and equipment costs on any orchard smaller than this are proportionately higher. Also, one man is needed on the farm a good share of the time, and particularly at critical seasons, almost irrespective of the number of trees. Orcharding can be fitted in with off-the-farm jobs if they are available and come at the right time. Not enough such jobs are available, however, in the Yakima Valley. As a result, many orchardists are not employed fully and their incomes are reduced accordingly. If in addition the owner's equity is too small, he is particularly vulnerable to low fruit prices. Two years of operations at a loss and he may be wiped out. The next size above the minimum for one man and one complement of equipment needs to be enough larger to use the full time of a regular hand at least from spring through the harvest. The number of additional regular workers that an orchardist can effectively direct and supervise by himself or with the aid of assistant managers sets the upper limit on size.

CHOICE OF SITE The discussion of localization above makes clear that getting the right site for an orchard is almost half the battle. Soil is not the major consideration, but some soils are much better for fruit than others. The really successful apple orchards in areas all over the country and especially in the nonirrigated areas are those which have just about the right combination of elevation, slope, exposure, and soil. Needless to state, access to markets is important in any new orchard developments. In the irrigated area in the West given over almost wholly to fruit, the sites having excessive spray costs are likely to produce low-quality and hence low-price apples.

SPECIES AND VARIETIES The Yakima Valley orchard that we have been considering has several kinds of fruit and several varieties of apples. These help to spread the peak labor, and also provide some price insurance. An orchard with only one kind of fruit has extreme labor peaks and is highly vulnerable to price fluctuations. The offsetting factor is that the site may not be well suited to two or more species. Markets, prices, and yields will mainly determine choice of varieties. Table 91 summarizes the experience with yields thus far with five apple varieties in the Yakima Valley. The record does not go much beyond twenty-seven years. During this same period, the prices of Delicious apples were over 30 per cent above the price of all apples; the prices of Winesaps

were about average; and those of Jonathan and Rome Beauty were nearly 30 per cent below average. The price advantage of Delicious has diminished, however, as their production has risen in recent years, until now it probably no more than offsets the somewhat lower yields. Individual orchards, of course, vary considerably in the prices received for their apples, because of differences in the grade and size of the apples. For the 1922–1933 period, Extra Fancy apples brought about 20 per cent more than the average price of all grades, and the C-grade brought about 25 per cent less.

TABLE 91. APPLE YIELDS PER TREE, BY AGE AND VARIETY, YAKIMA AREA, WASHINGTON

Variety	*Average yield per tree (pounds)*				
	2–5 years	*6–9 years*	*10–16 years*	*17–26 years*	*27 years & over*
Winesap	8	130	335	441	457
Delicious	9	97	305	409	428
Jonathan	13	180	309	367	387
Red Delicious	6	53	222	323	401
Rome Beauty	39	215	363	435	461

A special problem in combinations of species is that of the advantage of using fillers in a young orchard — such as peach trees or other varieties as fillers in apple orchards. The practice with respect to this may vary in the same area. Some orchards have gained by using fillers and some not. Local market conditions, weather, yields during the years when the filler crop is in good bearing, labor supply, and above all, the price of the land, will affect the results. Anyone setting out a new orchard should do the best possible job of pre-estimating expense and receipts in his location with and without fillers over the period in which the fillers are kept in the orchard.

AGE DISTRIBUTION AND REPLANTING It is obvious that if all the trees in an orchard are of the same age, they will have to be removed at approximately the same time. This will mean a long waiting period with no income and all outgo which many farmers will not be able to survive. The Yakima orchard we have been considering has fruit trees of several age-groups. A decade or so hence the apple and pear trees planted in 1914 will need to be removed. Because the Yakima Valley is a relatively new fruit-growing area, it has not really faced this problem yet. A complication in this area is that the continued heavy spraying has made

much of the soil toxic. There are several possibilities for replanting: (1) Set out young trees among the older trees, to be ready to bear when the old trees are cut out. Heavy shading by the old trees, and the soil toxicity may make this infeasible. Some horticulturalists, however, believe that it can be done. If so, it will be the most profitable method because it will reduce the time interval between one bearing lot of trees and another. (2) Remove the old trees entirely, and replant, perhaps in the same spots. The rest of the orchard will have to carry the load while this part of the orchard is out of production. There will still be the soil problems. (3) Remove the old trees and sow various crops to correct the soil toxicity before replanting. This may be necessary in order to get the young trees to grow, but it will be costly, especially because of the loss of farm income.

CONTROL OF DISEASES AND PESTS Two questions need to be asked concerning control of diseases and pests in any given situation. The first is, can they be controlled at all? The second is, will the costs of the control leave anything for the grower to reward him for his efforts? Control has largely failed in some cases. Black-raspberry production, for example, is sharply on the decline because of the severity of anthracnose and mosaic disease. Some of the intensive apple-growing areas of the Northwest have been close to collapse at times because control was proving too costly. In the Yakima Valley, apple growers have averaged about 6 sprayings, though some put on 8 or more. The 74 fruit farms studied in 1937 applied 163 gallons of spray per tree. On some farms the cost of spray materials alone was over $70 per acre. If spraying is neglected for a single year, the pests multiply so fast that their future control is difficult. Moreover, each grower is at the mercy of his neighbors, for if they do not spray systematically, he may be unable to protect his trees. For this reason, many states have enacted orchard sanitation laws which compel the orchardist to maintain a minimum standard of control, on pain of being fined or having his trees removed.

The need to spray apples to control pests has another result; the sprays contain lead arsenate, and a substantial residue of this material is left on the apples. These spray residues must be largely removed before the apples can be sold. Formerly, when less spray was required, it could be removed rather easily in packing sheds on the farm, operated by the farm labor supply. Not only has the amount of spray residue increased as pests have become worse, but the Food and Drug Administration has established lower spray tolerances. The need for these has been bitterly disputed by growers and others. In order to remove the larger amounts

of spray, and meet the lower tolerances, more elaborate washing, with hot solutions, is necessary. This could not be done on the average small orchard; as a result, the packing of the apples had to be transferred from the farm to a commercial packing shed.

PRICES AND MARKETING The problem of price variations resulting from fixed marketing cost is especially well exemplified by the California citrus fruits. All the citrus areas look to the northeastern fourth of the United States for their major market; 84 per cent of California's fruits and nuts are consumed outside of the state. The costs of getting the fruit from orchard to the final consumer are large and relatively fixed, with the result that farm prices vary far more widely, on a percentage scale, than do retail prices. The marketing charges for California navel oranges have averaged about $2.00 per box since the end of World War I, ranging from $2.65 for the 1920–1921 season to a low of $1.78 in 1934–1935. Most of the change has been due to changes in the general price level. The charges vary scarcely at all from year to year with changes in output or retail prices.

Of the total marketing cost of $2.00 for California oranges, about $1.25, or more than half, has been freight, and about 55 cents the packing-house charge for grading, sorting, and crating. The rest of the cost has been for picking, hauling, selling, and advertising. Retail prices of all oranges, as reported by the Bureau of Labor Statistics for all major urban markets, varied from 27 to 58 cents per dozen, from 1922–1923 to 1940–1941. In this same period, the price f.o.b. packing-house door varied from $1.38 to $4.45 per box, and on-tree prices varied from 68 cents to $3.57 per box. If, for example during the 1923–1930 period, the retail price of oranges had fallen as low as 35 cents per dozen, navel oranges in California would have been valueless on the tree. The costs of picking, grading, packing, shipping, and selling would have absorbed all of the consumer's expenditure. If the retail price had risen to 62 cents per dozen, the on-tree price would have been $4.00 per box. During the depression of the 1930's, however, the marketing spread declined so that the zero-value for oranges on the tree was at 18 cents per dozen retail, and at 43 cents per dozen retail the on-tree price was $2.00 per box.

The freight on Washington apples to large Eastern markets is roughly $1.00 per box. The costs of packing, boxes, warehousing, storage, and local selling have varied from 45 to 60 cents per box. As with oranges, these are relatively fixed, and the prices of packed apples f.o.b. packing house door have varied from less than 50 cents to over $2.00 per box, and the on-tree prices of apples even more.

The fruit grower is helpless in the face of these price fluctuations. Even if all the growers of a particular fruit were to restrict their marketings together, they would not gain by so doing except in the very short run. The fruit growers' gross incomes thus vary widely, and their cash costs are high and fixed. The net incomes thus vary from sizable losses to large gains. Other types of farms, to be sure, are subject to wide fluctuations in income, but few to as wide fluctuations as the fruit grower who is far from his market.

PRODUCTION ADJUSTMENTS In such circumstances as have been described, most manufacturers would reduce their output, perhaps even stop producing altogether, whenever their costs were not going to be covered by selling prices. Hog producers would certainly breed fewer sows, and dairymen raise fewer heifer calves and buy less concentrate. What can a Yakima Valley orchardist do? He could let the frost kill his crop if one came along at the right time, or even spray the fruit blossoms with a bloom-destroying spray. He would then have no need for harvesting labor, or for packing materials, and some other items. His costs would not, however, be reduced by more than $1,500. He would still have an annual cash cost of $1,500 besides supporting himself and family. The trees would need to be sprayed regularly, to keep them healthy and productive for another year, and also under the Washington orchard sanitation law, an uncared-for orchard is promptly removed by county officials. The operator of this orchard, therefore, has no practical alternative in the short run but to keep on producing. In the longer run, his only alternatives so far as prices are concerned are to find if possible some other fruit crop suited to his area that has better prices, or turn to truck crops, or shift to some much more extensive use of his land. Often the latter is the only real alternative, and this calls for a severe retrenchment.

Fruit farming thus involves long-term commitments, to a degree not experienced by most other kinds of farming. A truly informed decision as to the number and kind of trees to plant requires data on probable demand for this and competing fruits, for every year until the trees will normally be removed. Obviously, such data cannot be obtained. At the best, informed guesses will have to suffice. But once a decision has been made, it is usually revocable only at considerable loss. A mistake as to species or variety is not likely to be realized until the trees are of bearing age, and by this time, a fairly heavy investment has been made. If it is a particular variety that is no longer in demand, the trees, to be sure, can be top-worked to another variety; but such trees will yield lightly

for a few years and are likely always to be weak. This is only a way of salvaging something from the investment. When the mistake is choosing a poor site, ordinarily nothing can be salvaged.

In general, fruit growers have used bad judgment in their decisions to plant or refrain from planting. Periods of good prices have nearly always meant heavy plantings, followed by periods of low prices as these trees come into bearing, during which few plantings are made. Later, prices rise because of short production and a new cycle starts. Waves of over- and under-planting have been common for most types of fruit. A policy of orderly planting needs very much to be established in most areas.

A STRAWBERRY FARM [3]

Let us now take a strawberry farm in the Plant City area of Florida to illustrate the other extreme in length of commitment in fruit growing. Strawberry production in this area is closely associated with the availability of labor for picking strawberries. Usually the strawberry grower has the services of a large family of his own or of one or more sharecroppers or hired laborers. To enable school children to pick berries, the vacation period for the so-called "strawberry" schools in the area has been made to coincide with the main strawberry-picking season, January through March. Less than one fourth of the farms in the area now grow strawberries. The 1945 acreage of 1,200 was less than one third of that grown during the early thirties. This has come about mainly because of the jobs offered at relatively high wages in Tampa and areas near by.

A typical strawberry farm of medium size operated primarily with family labor, including the operator, his wife, and two or three children of working age, has approximately the following cropping pattern:

Strawberries	1.5 acres
Peppers	2.0 acres
Tomatoes	1.0 acres
Squash	1.0 acres
String beans	1.0 acres
Lima beans, pole beans, eggplants, okra, white potatoes, and other spring crops	1.0 acres
Crowder and blackeyed peas	3.5 acres
Corn	5.5 acres
Idle cropland	1.5 acres
Pasture, waste land, and farmstead	7.5 acres

[3] This analysis is based on preliminary information supplied for use here by Professor John R. Greenman of the University of Florida.

Except for strawberries, all of these are known as spring crops. The parent strawberry plants are obtained from the North for planting in a strawberry nursery bed in January and February each year; from each 1,000 parent plants, enough young plants are usually grown to set one acre in the following September and October; and the strawberry-picking season begins during December and extends through March. Most of the spring crops are planted in the latter part of December, or in January and February, and are harvested in April, May, and June. A variety of corn is grown which can be sold on the market as sweet corn or utilized on maturity as feed for livestock. It is usually interplanted with crowder and blackeyed peas, squash, string beans, and other crops that are harvested and out of the way before the corn is ready for cutting for the fresh market. The peak load for labor on such a strawberry farm comes during the strawberry-picking season.

Most of the farm family's consumption of vegetables, dairy, and poultry products is produced on the farm. The livestock usually includes a good milk cow, 20 to 50 chickens, one or more pigs and one mule.

Cash receipts and expenses on such a farm at 1940–1941 prices were $2,500 and $1,000, respectively, leaving $1,500 for living expenses, cash outlays for next year's crops, depreciation, and interest on investment.

One group of management problems of these farms centers around the management of the land. First is the need for plowing under a good cover crop to maintain the soil humus. Second is keeping the soil from becoming too acid by applying lime when needed and only in the amounts needed. Strawberries require a soil with a pH of around 5.5. To have maximum effect, the lime materials must be applied well in advance of plant-setting time. Some of the better farmers who do not regularly test their soil for acidity claim that they can determine its condition by observation. This is probably dangerous for the average farmer. Two out of forty fields studied in 1945 had very poor crops because the soil was too acid. Third is the preparation of the land. The more successful farmers usually double-disk the plant bed three or four times besides plowing it. Most farmers hire their disking done by tractor at $3 to $4 per acre in 1941 for double-disking. They do their plowing with one mule. Cutting out one or two of these diskings may seem to be an easy way of saving some expense, but it may reduce yields much more than the expense.

A major alternative on these farms is whether or not to install an irrigation system. Irrigation is used mainly in the new plant settings and in growing peppers, but to some extent for tomatoes, cabbage, and other crops. It makes feasible heavier fertilizer applications on peppers and tomatoes especially. Yields are estimated to be 25 to 40 per cent

higher for strawberries, 40 to 75 per cent higher for peppers and tomatoes, and the fruit enough better and earlier to add 10 to 25 per cent to the price. With irrigation, the $2,500 of receipts might become around $3,400. The depreciation and interest on the irrigation investment would range from $75 to $300 per year, depending upon the type of irrigation and accessibility of water.

Many diseases of vegetables and other crops are seed-borne. Inexpensive methods have been developed for treating the seed with chemicals to kill diseases. Only a few farmers treat their seed or intentionally buy seed that has been treated. One outbreak of a seed-borne disease will cost more than the expense of treating the seed for a lifetime.

Some of the farmers in the area produce summer and fall vegetables such as collards, turnips, squash, onions, okra, cabbage, and carrots for the Tampa produce market, as a way of obtaining year-round employment on their farms. The net returns from such crops are relatively low because of low yields and prices. The net returns are usually enough, however, to provide the family with a living during the summer months; provided too many farmers do not engage in such production. The demands of the Tampa market are easily exceeded. Hence, for many farmers there remains the problem of obtaining employment elsewhere or of accepting an income based on 8 or 9 months of full employment.

Such a strawberry farm needs to be large enough to allow selection of 5 or 6 acres of better low-lying soil for the very intensive crops such as strawberries, tomatoes, and peppers; and at the same time leave a few acres of higher land better suited to crowder and blackeyed peas, corn, string beans, and similar crops. Also, a farm needs enough cropland to allow a desirable rotation of crops, and provide pasture and roughage for the family cow, chickens, and pigs. This means at least 20 acres of land. Farms larger than this family-size farm usually handle their production and marketing problems better and get better returns per acre of any one crop and per farm.

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CHAPTER XLI

Vegetable Farming

THE FARMS MOST LIKE FRUIT FARMS IN THIS COUNTRY ARE THOSE WHICH produce truck crops or vegetables. Such farms offer an even wider assortment of species than the fruit farms — the census of 1940 gives data on forty-odd vegetables, excluding Irish and sweet potatoes. In number of farms reporting vegetables grown for sale, the top-ranking seven, in order, are tomatoes, sweet corn, green beans, watermelons, cabbage, cucumbers, and green peas; in acreage grown, the order is tomatoes, sweet corn, watermelons, green peas, green beans, cabbage, and cantaloupes. Although part of the vegetable farms, like fruit farms, grow only one or a few species, more grow a half dozen or so, so as to have some crop going to market from late spring until late fall. Again it is not possible to deal in detail with all the management problems of such diverse farming. Special attention will be given to two farms which illustrate the two major classes of such farms.

Of farms which have vegetables as their major source of income, the 1940 census reported only 80,000, compared with 134,000 fruit and nut farms.[1] Their products were valued at $180,000,000, of which $132,000,000 represented vegetables. Another 378,000 farms, however, had average vegetable sales of $178.

Many more farms grow vegetables for home use than grow fruit. In 1940, almost 4 farms in 5 had a vegetable garden, compared with 2 in 5 for fruit trees and 1 in 16 for small fruit. Furthermore, the ratio has been maintained as far as one can judge from the census figures — it was also 4 in 5 in 1910. No doubt many farm families have been buying vegetables in late years which they formerly grew in their gardens — buying them as fresh vegetables in stores, or canned or frozen; but most of them still grow the staple vegetables that are easy to grow, like tomatoes and green beans in the North, and collards and turnip greens in the South, and the newer vegetables swiss chard and broccoli.

[1] Irish and sweet potatoes are classified as "field crops" in the census. They were valued at $244,000,000 in 1940.

Commercial production of vegetables more than doubled between 1920 and 1940, and increased still further during the war. This resulted mainly from improvements in processing, transportation, and storage. Canning, drying, and quick freezing make it possible to preserve many vegetables from one season and area for consumption in another season and area; and modern transportation makes it possible to ship fresh vegetables from almost any area. Accompanying these developments have been others in the breeding of superior varieties and new techniques of production.

TYPES OF TRUCK CROPS AND TRUCK FARMS

One main differentiation in truck crops is between those grown for fresh consumption and those grown for processing. Prior to World War II, the annual per-capita consumption of fresh vegetables was around 130 to 135 pounds, and of canned vegetables (including vegetable juices) around 20 to 23 pounds. Seasonality of production is highly important for the first. Low cost and high quality are important for crops intended for processing. Because canned vegetables are relatively bulky in proportion to value, their production and processing close to the ultimate market may be important in keeping the final delivered cost to the consumer at a minimum. The western canning industry is based partly on shipping by water from San Francisco Bay, Puget Sound, the Lower Columbia, and adjacent areas, to markets on the Eastern coast.

The commercially grown vegetables consumed in largest volume fresh are tomatoes, cabbage, lettuce, celery, carrots, sweet corn, and snap beans. Cauliflower and spinach are next in rank, a half below carrots. The canned vegetables consumed in largest volume are tomatoes, sweet corn, peas, and snap beans. Frozen peas have encroached upon the canned product in recent years, and will encroach farther in the future.

Truck-crop farming tends to be differentiated in part in the same way as the truck crops:

A. Usually rather small farms located close around most of our cities, which grow a succession of fresh vegetables for local consumption.
B. Relatively large farms which specialize in some one or two fresh-market crops to which their soil and climate is particularly adapted. The farms may produce lettuce, celery, asparagus, snap beans, onions, or almost any vegetable that is used in large volume. Centers of such farms are in the Salinas and Imperial Valleys in California, the Salt River Valley in Arizona, southern New Jersey, the South Atlantic area, southern Texas, and southern Florida. But

some farms of this type are found within hauling distance of most large cities.

C. Farms, similar to the above, which produce vegetables and small fruits for processing, usually under contract with canning and processing companies. During the early part of the season, the crop may be shipped to fresh market; this is a regular practice with tomatoes and asparagus particularly.

D. General farms which include one canning crop like peas, sweet corn, tomatoes, or cucumbers for pickling, in their programs; or which may produce some one or two vegetables for local consumption fresh. These farms are not likely to be classified as "vegetable farms" by the census. They were mentioned briefly in Chapters XIII and XIV.

LOCALIZATION

Many of the D-type farms described above are found in the South and East. Many southern farms grow cotton, corn, and truck crops, and have a few head of livestock. The prices of the vegetables sold are highly variable. Cotton prices and income are more stable and regular. Though the per-acre income from cotton has not been the highest in frequent years, it has averaged as high as any in the recent past. Truck crops and cotton therefore tend to be grown on the same farm in areas scattered over the South. From the Chesapeake Bay northward, the D-type truck farms fall in two groups: farms relatively specialized and usually small, and farms somewhat larger and more general that grow sizable acreages of truck crops along with feed crops and dairy cows and other livestock.

This chapter, however, will mainly concern itself with the A, B, and C types of farms. There were 22 type-of-farming areas and sub-areas in 1930 in which the A, B, and C types of truck farms were dominant. A fifth of these truck farms were in the South Atlantic region, with centers in Delaware, Maryland, and Florida; 17 per cent in the East North Central states, centering around the large cities of the region, including the southwestern Michigan area near Chicago; and 16 per cent in the Middle Atlantic states, including especially New Jersey and Long Island and western New York. Thus, over half of the truck farms were along the Atlantic sea board and north of the Ohio River. The Pacific region had only 11 per cent of the farms. However, the Pacific Coast farms were so much larger than those of other regions that they received 27 per cent of the income from all truck farms. Florida had more truck farms than California or any other state in 1929; but the California farms had $3\frac{1}{2}$ times as much income as the Florida truck farms. The Northeastern

truck-crop areas have faced increasingly severe competition since World War I from the Southern and Western areas because improved transportation and marketing methods have brought them within the orbit of these large urban markets.

The factors determining localization of vegetable farms are mainly soil, water, and markets. Sometimes these three requirements are found in the same area and sometimes not. Thus the best vegetable soils in New England are in the Connecticut Valley, much of which is a hundred miles or more from any really large cities. Boston has little first-quality vegetable soil near at hand. Much truck growing is found around larger cities on land that is only fairly well adapted to the vegetables grown.

It would seem from the foregoing that truck-crop growing and fruit growing are found in the same general areas. In California, however, the Imperial Valley is an important truck-crop area but grows little fruit. Even within the Central Valley of California, truck-crop growing is found in the valley floor north of the large vineyard areas, and west of the foothill fruit areas. In Florida, citrus fruit is produced chiefly in the center of the state; truck crops, largely along the eastern coast to the south and within the Everglades area. Small fruits and vegetables are more likely to be found in the same localities than tree fruits and vegetables.

Let us consider briefly the localization of production of the major vegetables. A long list of these are grown commercially in several parts of the United States, but differ much in distribution. Tomatoes are grown on large acreages in central California, southern Texas, southern Florida, along the Atlantic Coast north of the Chesapeake, and in a belt across northwestern Ohio and down through central and southern Indiana. Sweet corn for processing is primarily a crop of the Northern states, where the cool weather permits a long harvesting period, and pests and diseases are not so troublesome. The major producing areas are in southern Minnesota, southeastern Wisconsin, northern Illinois, central Indiana, southern Ohio, western New York, and central southern Maine. Green peas for processing are grown in somewhat the same areas as sweet corn, and for the same reasons, and also in local areas in Washington, Oregon, and Utah. Green peas for fresh market are grown mostly in California from fall until the following summer, and in the higher and cooler altitudes of Colorado and Idaho during the summer months.

Watermelons are largely a Southern crop, with localized producing areas in Texas, Florida, Georgia, South Carolina, and other southern states. Some early season production is found in the Imperial Valley of California, but otherwise the Western areas produce only for local con-

sumption. Texas and the Southeast supply the Midwest and Eastern markets clear to the Canadian line. The green-bean areas are mostly along the Gulf and up the Atlantic Coast. Cabbage is grown in this same general region, but with heavy concentration at points in southern Texas, western New York, and in smaller districts through the South and East. Dry onions are grown in widely scattered areas from Texas in the South to California, Colorado, and Idaho in the West, to Michigan in the North and New Jersey and Massachusetts in the East. Cantaloupes and similar melons are also grown over a wide territory — California, Colorado, Texas, Georgia, South Carolina, Michigan, New Jersey, and other states.

In contrast with these vegetables of relatively wide distribution are those produced chiefly in one or a few states. The most important crop in this category is lettuce, two thirds of which is produced in California and half of the remainder in Arizona. Other important vegetables in this group are celery, grown chiefly in California, Colorado, Michigan, and Florida; asparagus, grown very largely in California, South Carolina, and the New Jersey-Delaware-Maryland area; carrots, grown commercially largely in California, Texas, and a few local Northeastern areas; and other less common vegetables such as broccoli, beets, cauliflower, and spinach, each of which tends to localize in a few small producing areas.

VEGETABLE FARMS IN GENERAL

Vegetable farms differ from most fruit farms in that they can shift quickly from one type of production to another. As a result of this, new truck areas come into production in a few years, often only to be displaced by other newer areas presently. The well established truck-crop areas, however, shift very little — they have high comparative advantage in vegetable growing because of location or climate.

The A-, B-, and C-types of truck farms keep as little livestock as do the fruit farms. Of 22 counties located in the 22 type-of-farming areas in which truck farms are dominant, only one averaged more than two dairy cows per farm. A work animal or two is almost essential, even with a tractor on the farm, for some of the cultivating and hauling; and a dairy cow or two, a pig, and a few chickens may be kept to produce for the family. The crops grown in rotation with vegetables are commonly more valuable for green manure than for feed. On many D-type farms, however, the residues of such crops as sweet corn or peas are used for livestock feed.

Although truck farms are not usually very large, they tend to be located near large cities or on land of high economic capacity if not natural fertility. Truck-farming land is also maintained at a high level of tilth and fertility. In the 22 counties studied, the value of land and buildings per acre of cropland harvested in 1929 exceeded $1,800 in Los Angeles County, California, was nearly $1,200 in Cook County, Illinois, and was over $950 in Suffolk County, New York. In several other counties, the value was from $300 to $500.

Even the small family-size truck farms hire considerable labor. The wage bills in the 22 counties studied ran from $200 to $600 on essentially family farms hiring extra labor mainly at harvest. In counties with large truck farms, one dollar in each three dollars of cash outlay was for hired labor. The largest of these farms employ specialized managers and foremen. Both the growing and the harvesting of vegetables use much hand labor. Tractors and improved implements can be used to prepare the land for planting; transplanting machines also save much labor; and part of the cultivating can be done with tractors and wheel hoes; but the hand hoe is still an essential tool on the ordinary truck farm. On such truck farms, the harvesting is mainly a hand operation. In the specialized Western areas, however, much of the preparation for market is mechanized to a high degree in the packing sheds; washers, assembly lines, automatic box-making machines, and other factorylike techniques have been installed. Still, half of the California truck crops before the war were using from 100 to 200 hours per acre to grow, harvest, and pack an average crop, and a third of them were using over 200 hours per acre. Methods of saving labor on such farms were discussed in detail in Chapter XXVI.

Truck farms have relatively small acreages. In the 22 counties studied, the cropland harvested averaged less than 20 acres per farm in 7 counties, and less than 40 acres in four fifths of them. Even in Imperial and Monterey Counties, California, they averaged only 125 and 101 acres, respectively, of cropland harvested. Truck farms simply do not use a large area of land. Even those with large gross incomes obtain it from a small area. The land is intensively operated — much labor and materials combined with a small area of land.

In terms of value of product, however, the range is very wide, from less than $2,000 per farm in 5 of the 22 counties, and less than $5,000 in three fourths of them, to an average of around $20,000 in Imperial and Monterey Counties. In Imperial County, 215 truck farms had gross incomes over $20,000, averaging over $50,000. These 215 had at least 80 per cent of the income from farms of this type in the county in 1929;

hence some of them must have been very large. The same general situation prevails in Monterey County, where the well-known Salinas Valley is located, and in the Lower Valley, Laredo, and Winter Garden areas, in the Coastal Bend area of Texas, and in the Lake Okeechobee area of Florida. Comparable data are not available for 1940, but it is known that the large truck farms in California, Texas, and Florida are larger now than in 1930. There are still many small truck farms in California, particularly those producing for local markets and for canneries, but the large operators dominate the production of fresh vegetables for shipment to Eastern markets.

A TYPICAL EASTERN TRUCK FARM [2]

Further discussion of the management aspects of truck-crop farming will be more meaningful if we can first look at a couple of actual farms, one a small multiple-crop type, and one a large specialty-crop type in the West. The farm chosen to represent the first is located in Cumberland County, New Jersey. The leading vegetables in the county in 1929 were green lima beans, 7,020 acres; snap beans, 4,550 acres; tomatoes, 4,120 acres; asparagus, 3,330 acres; green peas, 2,740 acres; peppers, 1,820 acres; and onions, 1,020 acres. The county is thus a diversified truck-crop area. There were 942 truck farms in this county in 1929, and 752 in 1939. Detailed data are available only for 1929. The farms then averaged 64 acres in size, with 32 acres of cropland harvested, and production valued at $3,550. The average farm had 1.8 horses and 1.4 dairy cows, and spent $529 for fertilizer and $861 for hired labor. These figures indicate a rather small, intensively operated farm, with the operator doing a good share of the farm work.

The particular truck farm chosen from this area has 40 acres of land, of which 29 acres are usually cropped, 2 acres are in pasture, and the other 9 acres are in farmstead, waste, and woods. The operator spends all of his time on this farm, hires one man for 30 weeks during the summer, and hires other labor by the day as needed. The farm has a general-purpose rubber-tired tractor for field work, and a truck for hauling produce out of the fields and to market and for miscellaneous tasks. The one horse is used mostly for cultivating crops when the tractor cannot be used.

[2] This analysis is based on studies of adjustments on truck-crop farms in Monmouth and Cumberland Counties, New Jersey, made by John W. Carncross and Richard G. Wheeler, for the New Jersey Agricultural Experiment Station and the Bureau of Agricultural Economics.

The usual cropping program for this farm, with sales at the average prewar prices, is about as follows:

	ACRES	YIELD PER ACRE	PRICE PER UNIT	SALES
Lima beans	10	72 bushels	$ 1.24	$892
Onions (dry)	5	274 50-lb. sacks	.69	945
Canning tomatoes	$4\frac{1}{2}$	5.1 ton	15.17	355
Spring lettuce	3	400 crates	.53	636
Fall lettuce	1	400 crates	.53	212
Snap beans	2	102 bushels	.88	180
Early potatoes	1	100 bushels	.60	60
Corn for grain	3	38 bushels		fed
Clover hay	1	1.4 ton		fed
Soybean hay	2	1.5 ton		fed
	$32\frac{1}{2}$			$3,280

The fall lettuce is grown on the same land as the spring lettuce, with a green-manure crop of cowpeas in between, and the potatoes and soybeans are grown on the land from which an early crop of onions, from sets, was harvested the first week in July.

The cash expenses on this farm, which add up to $80 per cropland acre, were as follows in the same prewar year:

Hired labor	$730	Gasoline and oil	$130
Seeds and plants	422	Spray and dust	44
Fertilizer	461	Taxes	110
Lime	36	Repairs and servicing	90
Containers	392	Miscellaneous	75
		Total	$2,490

The $790 of net income from these operations, less $160 for depreciation of buildings and equipment, left a rather small income for a full-time commercial farm in an area so near large urban employment centers. The family could not easily, out of such an income, pay off the mortgage debt of $1,850 on this farm. Of course, these prewar years were poor years for agriculture almost everywhere.

No regular rotation is followed on this farm. All the crops (except the clover) are annual crops, and can be expanded or contracted as the market outlook warrants. This farm obviously has many small fields whose boundaries shift from year to year. All the land must be fitted for crops each year. Fertilizer is used freely on all crops. Constant cropping uses up the humus. The horse manure once available in cities near-by almost solved this problem. The nearest substitute is green-manure crops plowed under in the spring. A suggested reorganization of this farm would substitute 5 acres of clover used as green manure for 5 acres of

lima beans. The immediate effect would be a loss of income, but available data indicate that within five years the crop yields would rise by 15 per cent and restore gross income to present levels while reducing cash outlays for fertilizer.

Most of this farm's cash costs are the same regardless of prices except that wages and some other costs may decline somewhat in prolonged severe depressions such as in the 1930's. But they do not rise in high-price years, unless these continue as during World War II. In any event, the cash farm operating costs change much less than the prices of vegetables.

Finally, the farm has a complex marketing problem for such a small business. The tomatoes are delivered to a canning plant, and the other products are trucked directly to Philadelphia or New York, sold on the farm to truckers, or sold at intermediate points to handlers of various kinds.

This type of truck farm, in spite of much talk that one hears about factory farming in vegetable production, is usually found all along the Atlantic seaboard, in much of the South, in western New York, around cities all over the eastern half of the United States, and also around Western cities.[3] Large-scale operations can be found also, but they are not typical except in certain areas. These are essentially family farms, but adapted to the peculiar circumstances of truck farming. They are larger than family size if one counts in all the labor hired.

Farms of this type and size operate under severe handicaps. Their volume of output is too small for efficiency in production and skill in marketing. Fields and acreages of each crop are small, making mechanization and laborsaving difficult. It is also difficult to be proficient in the technical details of producing a half-dozen crops. The small volume of each crop does not attract the large specialized buyers, nor allow the grower to become specialized in marketing. The increased production in more distant but perhaps more efficient producing areas has put heavy pressure on local vegetable prices in recent decades. New and improved processing methods have increased the competition between processed and fresh vegetables, and promise to increase it still further in the post-war years. World War II gave Eastern truck farmers a reprieve from such pressure, but the return to more normal conditions will bring a resumption of it.

But these Eastern farms also have some important advantages if they can find a way of exploiting them. First and foremost, nearness to a large

[3] In the South, such a farm commonly uses mules for power instead of tractors.

body of consumers can mean nearness in time, if there is an efficient marketing setup, and this can mean superior quality. Some vegetables lose much in quality and flavor in a few hours. More careful grading and preparation for market, plus a system that will give more direct delivery from farm to ultimate consumer, can give the local producer an important price advantage. The possibilities of cooperative organization have not all been realized. Somewhat larger farms and larger fields, as well as machines adapted to smaller acreages, would make possible large savings in labor. Work simplification procedures can increase output per man. Finally, these Eastern growers may possibly find a way of combining quick freezing in small local plants with their production for the fresh market, so that they will be able to supply the local markets more or less over the year.

A LARGE WESTERN GROWER-SHIPPER

No more violent contrast can be found in the agriculture of this country than that between the farm just described and the one we are now presenting. This is a farm in the Salinas Valley of California, whose normal cropping program includes 1,500 acres of lettuce, 125 acres of carrots, 100 acres of celery, 125 acres of broccoli or cauliflower, 150 acres of sugar beets, 150 acres of dry beans, sometimes 100 acres of vegetable and flower seeds, and some ladino pasture and alfalfa. The acreage of crops considerably exceeds the acreage of cropland, since much land grows two crops per year, and a little of it three crops. The lettuce yields 150 to 160 crates per acre or a half car; the carrots yield 250 to 275 crates per acre, and celery 600 to 700 crates.

In most years this farm ships to Eastern markets 750 cars of lettuce, 100 cars of carrots, 150 to 200 cars of celery, and 100 cars of broccoli or cauliflower, plus some lettuce purchased from smaller farmers. The packing shed operates most of the year. The broccoli or cauliflower is grown largely to keep the packing shed operating in the winter time when other crops are at a low point.

This particular grower-shipper also maintains a beef-cattle herd to salvage the large quantities of lettuce trimmings and cull heads. Cattle will dispose of 100 pounds per head per day of this forage. When lettuce is not being shipped, the cattle feed on the ladino clover. A calf born in the fall, fed all the lettuce or ladino it can eat until a year old and then grain-fed in a dry lot for 3 or 4 months, will weigh nearly 1,000 pounds at 16 to 18 months of age.

To understand this operation, we need to know that the Salinas Valley

opens out to the sea about a hundred miles south of San Francisco, has a very nearly uniform temperature, and will grow some vegetables in all months of the year. The irrigation water is all pumped from wells. The lettuce acreage rose from nothing to 44,000 acres in 20 years before 1939. In fact, in 1919, the census reported only 543 acres of vegetables in Monterey County. In 1939, the count was 60,000 acres. The vegetables have taken the place of alfalfa. The sugar-beet acreage also declined sharply from 25,000 acres in 1919 to 200 acres in 1929, but recovered to 15,000 in 1939.

At the start, the vegetable production in the Salinas Valley was in the hands of individual farmers. Today, 60 per cent of it is produced by corporation shippers. The packing, shipping, and marketing are really the controlling phases of this enterprise. The large investment required in the packing shed, and the high risks from price changes, have caused this industry to pass into the hands of corporations. Half of the Salinas grower-shippers, the larger ones, have similar operations in one or more other areas, perhaps in the Imperial or San Joaquin Valleys, or in the Salt River Valley of Arizona. The vegetables grown, and their season, in these other locations are such as to fit in with the Salinas Valley production and make a continuous shipping program. The packing shed must also include an ice plant; cracked ice is packed in every crate of lettuce shipped beyond the Mississippi, and in addition, from 5 to 10 tons of ice is blown into the top of each car before it is sealed.

The company whose operations are reported here limits itself to the Salinas Valley, and is only medium-sized. It owns about 300 acres of cropland, and regularly rents two farms ("ranches"), one of 550 acres for which the cash rental in 1945 was $21,500, and another of 350 acres for which the cash rental was $15,000. Some properties in the Valley rented in 1945 for as high as $70 per acre. Much of this land is owned by descendants of early large landowners, who retain their lands as income producers and rarely sell.

A major production problem is proper soil management. To maintain the humus, the usual practice is to haul steer manure from the San Joaquin feeding yards 100 miles away, at a cost of $4.50 per ton at the farm during the war. An application lasts three years. Two tons of poultry manure are applied per acre of lettuce and celery every year. This is hauled 150 miles from the Petaluma area at a cost of $9.50 per ton at the farm. Fall and winter cover-cropping and green manuring is beginning to take the place of the steer manure.

Part of the soil in this area is heavy and cloddy and needs subsoiling and thorough tillage. The soils range from light to very heavy, the best

soils being the intermediate silty loam soils on the second benches. The upland soils are shallow with a hardpan and can be used to grow lettuce only in the spring, in rotation with dry beans. The common crop sequences in the better soils are carrots and fall lettuce; spring lettuce and fall lettuce; broccoli or cauliflower harvested in March followed by lettuce; and summer lettuce followed by Canadian field peas as a cover crop.

The field and packing-shed operations are as nearly mechanized as possible. Celery is set with three-row plant setters. The lettuce is seeded by machine, but must be thinned and weeded by hand. In harvesting, the lettuce is cut with a knife, the cutter selecting the heads. The carrots are "lifted" with a machine, but are washed and bunched in the field. This farm employs 75 to 100 "stoop" laborers and irrigators and 15 tractor drivers. Conveyor belts may be used to load the lettuce into the trucks in the field, and these trucks are built to unload big baskets of lettuce directly onto the benches in the packing shed. The packing-shed work is laid out in a line operation. Still, a large amount of labor is needed. The packing shed on this farm employs 75 workers.

The field workers operate in crews under a foreman. Before the war, they were largely local Mexicans and Filipinos. During the war, Mexican nationals were brought in under arrangements with the Mexican government. This grower-shipper maintains three labor camps. The packing-shed workers are mostly white men and women, many of whom have moved to California in recent years. At the piece rates paid in 1945, and at ceiling performance, packers earned $2.00 per hour and trimmers $1.60, for an 8-hour day, plus time-and-a-half for overtime. When labor was plentiful, shed operators preferred to hire by the hour, regulating the output so as to permit careful packing and a minimum of bruising of the lettuce. The desired rate of operation was 20 crates per hour for a packer and four trimmers. As labor became scarcer during the war, the unions put on pressure for piece-rate pay, by slowing down performance on hourly pay. The rate fell off to 17 crates per hour, and even as low as 14 in some plants. With a shift to a piece-rate basis, the output jumped but the quality of the work declined. Operators insisted on a ceiling of 40 crates per hour per packer. In an 8-hour day, a packer and his trimmers handle a full car of lettuce (312 to 320 crates). A more-or-less standardized crew includes 8 packers, 32 trimmers, and other miscellaneous operators along the assembly line. Crates roll off such a line at the rate of 300 per hour, or one every 12 seconds; they weigh 110 to 125 pounds, including the ice and crate. The whole operation is well synchronized, with a steady flow of supplies and materials at every stage.

The farmers who are not also shippers may grow lettuce under a

ing areas, and (4) production in the competing area coming to market earlier or later than normal. For instance, cabbage from an "early" producing area in Texas may arrive unusually late, bringing high prices at the beginning of the shipping season, but later very low prices because of lapping over on the cabbage from the "second early" producing area in Mississippi. Contrariwise, a freeze in a competing district may mean a large profit in some years. High incomes one year tend to be followed by losses the next, since producers often increase their acreage after a year of high returns. The relatively distant areas, whose marketing costs are largest, usually have the widest fluctuations in prices at the farm.

The problems of marketing vegetables are acute also. Most vegetables are highly perishable. Once ready, they must be shipped with little delay; and once reaching the market, they must be sold for what they will bring. A wide range of marketing channels is found over the country. Originally, and to a considerable extent still, in the truck-farming areas surrounding large cities, vegetable growers sell to retail stores or even directly to ultimate consumers. The peddler's cart or truck, the stall in a public market, and the roadside stand in recent years, are the usual means of reaching the housewife. Sometimes a fairly permanent channel is set up between the grower and retailers. These more direct methods have their advantages — the vegetables are likely to be fresh, and the grower quickly hears about any shortcomings of his product. The great obstacle to such direct selling is that the retailer cannot obtain his full supply of vegetables the year round from local sources, and he gets to relying upon central markets at all seasons. From the grower's angle direct selling may take too much time. In consequence, an increasing volume of vegetables is sold in wholesale markets. Or a truck operator, interested primarily in getting hauling to do, may buy from the farmers and sell to retailers or in an organized market. Auctions have developed in many Eastern producing areas, the buyers at these auctions being shippers and truckers, dealers in the wholesale markets, and to a limited extent the larger retailers.

Sorting, grading, and packaging vegetables are by no means simple problems. The small grower distant from the market, like many Southern growers, often thinks that he is imposed upon when he is told that his product was off-grade when it arrives; and in some cases he is right. On the other hand, small growers do not always grade carefully, or even honestly. They often lack the volume, the equipment, and the skill needed to produce a really good pack, and many of them do not appreciate the importance of careful preparation for market. The large producers have an important advantage in these respects. Small producers

have been able to overcome this disadvantage in some areas by forming cooperative marketing associations with packing sheds.

With so much hired labor on truck farms, its efficient use is a major factor in their successful operation. Problems are involved in the recruitment of such labor, in directing its operations in the field, and in protecting the quality of the product. Many of these operations are very tiring, but because they are repetitious the workers acquire a high degree of skill. Experienced workers are therefore much preferred. But the needs for such workers are so highly seasonal in nearly all areas that only by migrating can they earn a livelihood from it. And a migratory life cannot be expected to appeal to high-quality workers.

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CHAPTER XLII

Dairy Farming

THIS CHAPTER IS DESIGNED TO INTEGRATE THE SEVERAL ANALYSES OF aspects of dairy farming that have been introduced in earlier chapters and to analyze briefly the important problems of dairy farm management still remaining, which are, in considerable measure, problems of management in city milksheds. The problems already analyzed include the following: (a) rate of feeding and balancing of rations, in Chapter IX; (b) the combination of dairying and the production of feed for dairy herds, in Chapter XI; (c) replacements for dairy herds, in Chapters IX, XI, and XIV; (d) the combination of dairying with cash crops, including cotton, wheat and other small grains, corn, tobacco, and potatoes, in Chapters XIV and XV; (e) the problem of size of dairy farms, and methods of cost analysis, in Chapters XIX and XXI; and (f) frequent reference to the labor, equipment, marketing, and financing problems of dairy farms in the chapters in PART FOUR.

The 1930 type-of-farming map has 129 areas and subareas in which dairying is the major source of income, and 160 more areas and subareas in which it is an important auxiliary source of income. The location of these is pretty well indicated by maps and discussion in earlier chapters. They are mostly in the northeast quarter of the United States, north of the Corn Belt and east of the Great Plains grain and livestock areas. Another small concentration appears in the North Pacific states. Elsewhere, the dairying is mostly in the city milksheds or in irrigated valleys. Dairying has been pushing westward into the Great Plains all the way from North Dakota to Texas, but most of the dairying of this region is supplementary to the major enterprises. It has also pushed southward into the northern third of the Corn Belt in the last twenty-five years, as shown in Chart 44 in Chapter XI, mostly in combinations with corn and hogs, replacing beef cattle with dual-purpose or even dairy types. Dairying has also expanded on the general farms of the border states from Missouri eastward to Maryland and Virginia, south of the Corn Belt proper.

THE ORGANIZATION OF THE DAIRY INDUSTRY

TRENDS IN DAIRY PRODUCTION The number of milk cows has multiplied 3.4 times since 1870, and 1.7 times since 1900. In the same periods, the number of "other cattle" has increased 2.5 times and 1.2 times. Chart 68 in Chapter XX shows that the number of other cattle increased most before 1890 when the Western ranges were being settled, but the number of milk cows after 1890. The so-called "cattle cycle" apparent in the chart does not seem to have included milk cows. The hump in 1933, it is apparent in Chart 120, was an incident of the Big Depression. The price of cull cows was so low, and feed so abundant and cheap, that farmers did not cull at their usual rates. Production per cow, in consequence, fell off to a very low level. Chart 121 which draws numbers of milk cows and of calves and heifers raised *to the same scale*, shows that changes in numbers of replacements have contributed to changes in numbers of milk cows only in mild degree.

No data are collected that really represent changes in prices of milk cows as such. Those shown in Chart 68 are obviously the prices of cull cows and not of milk cows. Dairy product prices do not follow this cyclical pattern.

Expansion of dairying seems to come gradually but surely. Some of the administrators of the wartime food program failed to sense this until the war was about over. They asked for 125 billion pounds of milk in 1942 and got only 119 billions. The next year they moderated their demands to 122 billions and got 118 billions. Not until 1945 did production reach 123 billions.[1] Rarely does any real contraction take place. Even in northern New England, the herds have increased enough in size in the valleys and intervales to offset the declines back toward the mountains.

UTILIZATION OF PRODUCT The unique feature of the dairy industry is the diversity of uses of its product. The 109.5 billion pounds of milk produced in 1940 was distributed 41.6 per cent to fluid milk or cream, 41.6 to butter, 7.2 per cent to cheese, 5.4 to evaporated and condensed milk, and 4.3 to ice cream. The 9 billions more produced in 1944, plus the cut in butter's share of it, went mainly into fluid milk, cheese, and evaporated milk. Additional subsidies were paid on milk delivered whole to make more of it available for these uses. Charts 122A, B, and C show the relative changes in use from 1924 to 1944. Fluid milk and butter ran about even until 1941, with neither increasing as rapidly, percentage-

[1] These estimates are more inclusive than those shown on Chart 121.

wise, as the other three. The consumption of ice cream is influenced strongly by unemployment.

The ten leading states in butter production in 1940 were Wisconsin, Minnesota, New York, Iowa, Illinois, Ohio, Michigan, California, Texas, and Pennsylvania. The first four of these produced 31 per cent

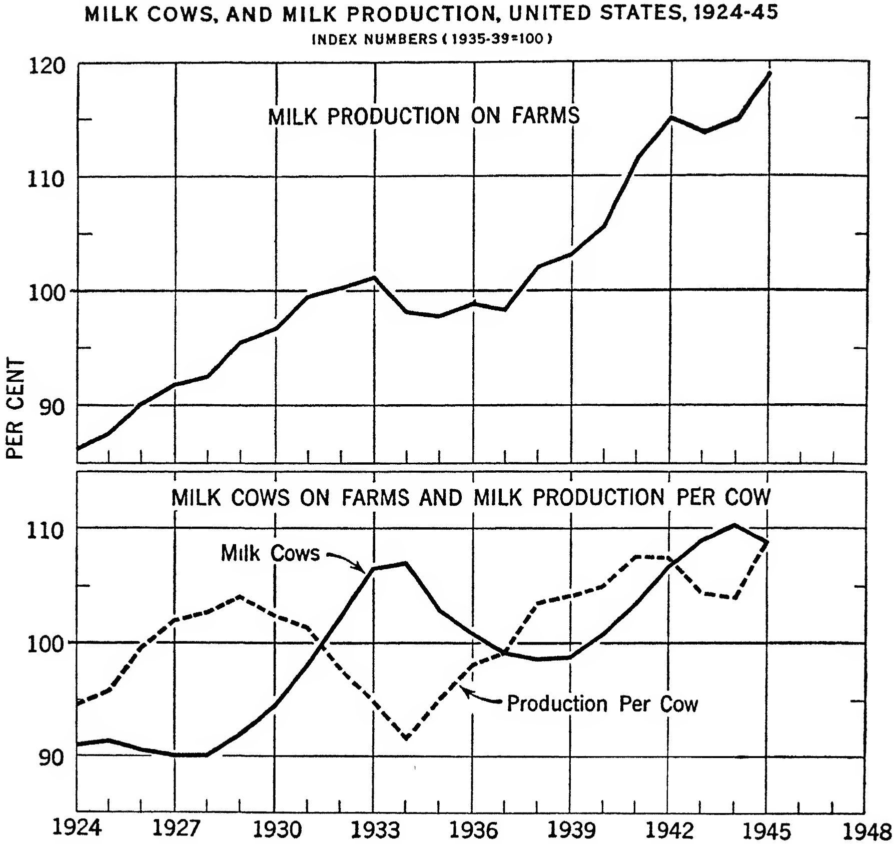

CHART 120. Milk cows on farms, and milk production per cow, United States, 1924–1945. (*Outlook Charts*, 1946, p. 87.)

of it. Wisconsin produced as much cheddar cheese as the nearest competing two states combined. Wisconsin also produced three times as much evaporated milk as any other state. Next in order are Ohio, California, Illinois, and New York.

PRICES Chart 123 shows that the prices of dairy products ran higher than the average for all farm products after 1920 until 1945, and especially higher than the average for farm crops after 1925. They also ran

higher than the prices of all livestock and livestock product prices from 1919 until 1941. In both wars, other livestock prices ran ahead until around the end. Numbers of cows were increasing somewhat more than usual at the start of both wars, but the major factor was the sharp increase in the demand for meat and animal fats caused by the war. It is obvious that "parity prices" figured in terms of either 1925–1929 or 1935–1939 would be more in keeping with current inter-commodity price relationships. Dairy product prices have run this high in part because dairy

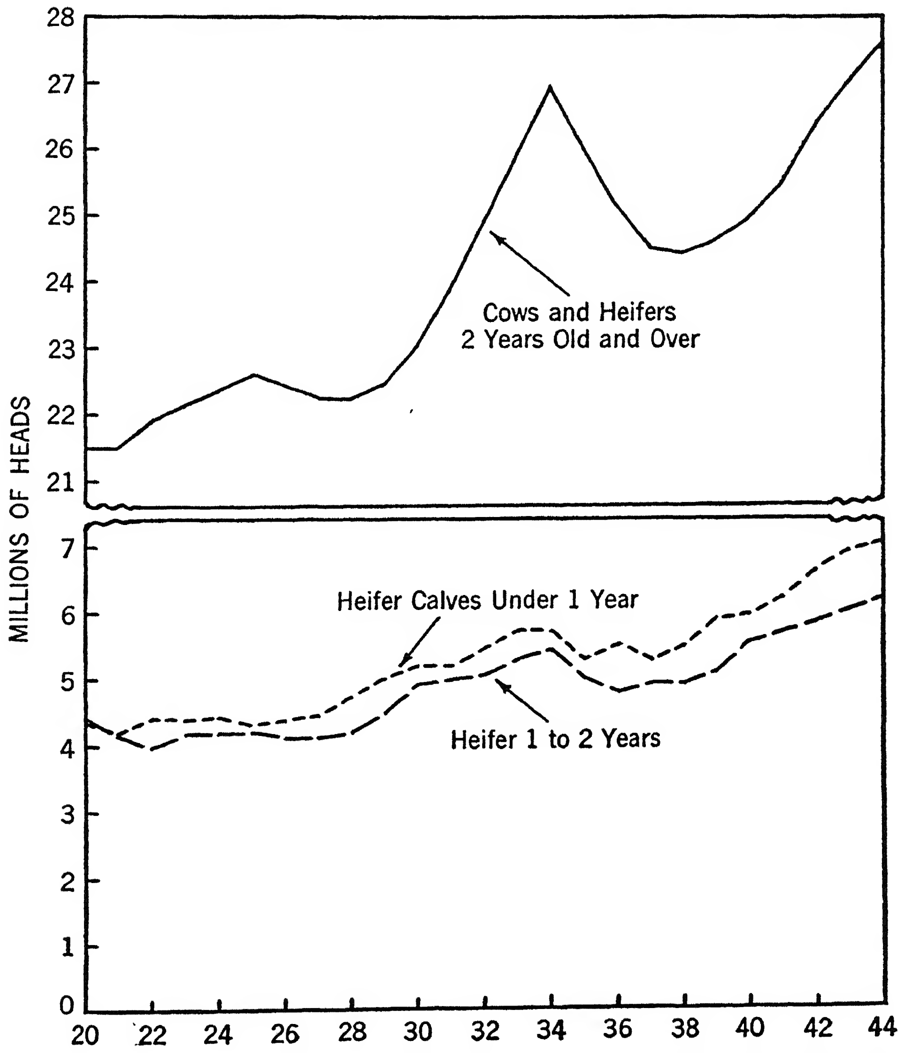

CHART 121. Number of dairy cows, heifers, and calves on farms, 1920–1944. (Sources of data: Table 437, *Agricultural Statistics*, 1944.)

production has not benefited as much as crop production from mechanization, and in part because demand has been increasing relatively. High-level employment in the next decade would widen this spread still further.

The geographical dispersion of prices received by farmers for dairy products, shown in Chart 124 is very wide. In 1940, this range was from

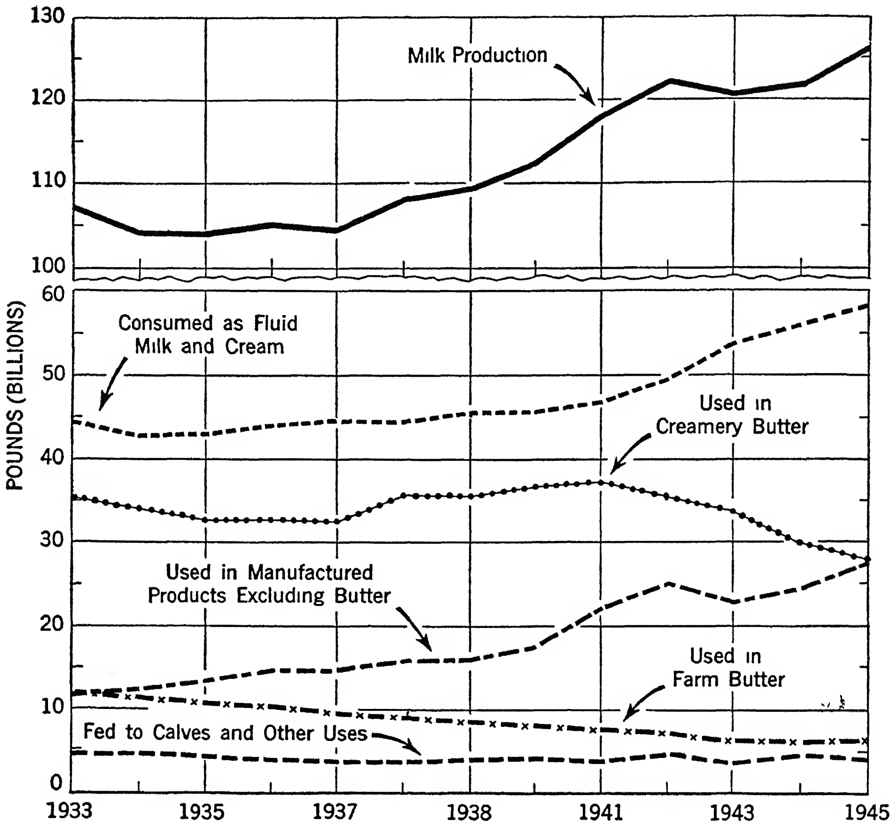

CHART 122A. Total milk production and utilization, whole milk or whole milk equivalent, United States, 1933–1945. (Includes nonfarm production, estimated at 2,826 million pounds annually.)

$4.11 per hundredweight for all milk sold in Florida, and $3.28 in Massachusetts and $3.26 in South Carolina, down to $1.09 in the Dakotas, around $1.20 in Iowa and Minnesota, and $1.41 in Wisconsin. The largest factor in these differences is the proportion of the milk that is consumed as fluid milk as distinguished from use in making butter, cheese, or evaporated milk. This largely accounts for the difference

between prices in Vermont and Massachusetts. Prices in the Dakotas are lower than in Wisconsin because nearly all of the milk goes into butter, and into relatively poor butter at that, since much of the cream is shipped sour. Wisconsin now delivers considerable fluid milk to Chicago, and Michigan still more to Detroit and to other industrial centers. A considerable proportion of New York's milk was still going into processing plants in 1940, or being sold as fresh cream, which use

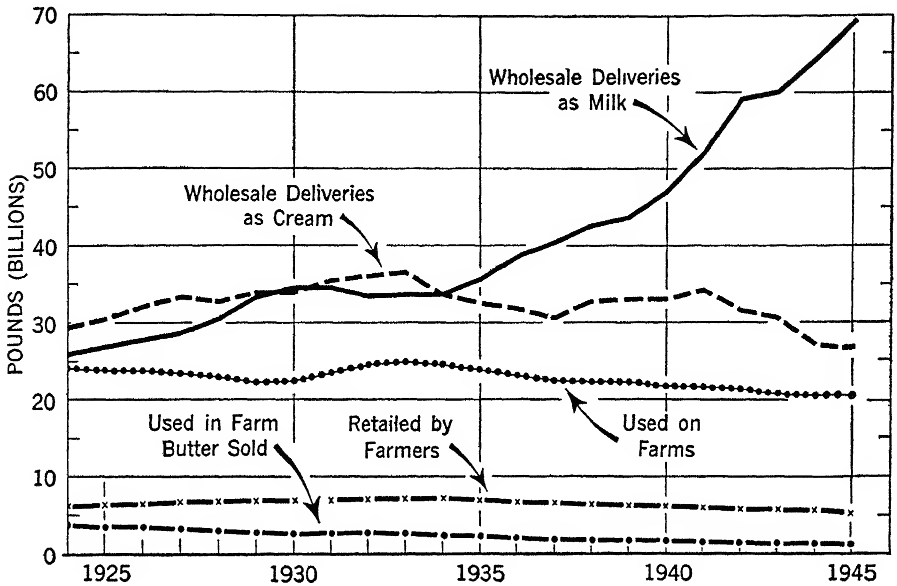

CHART 122B. Disposition of milk produced on farms, United States, 1924–1945. (Milk equivalent)

returns only a little more than use in butter or cheese. Vermont had a large surplus of milk being sold at cream prices in 1940. Idaho's milk goes into butter largely; likewise, much of Colorado's output. These price differences profoundly affect the organization of dairy farms in different parts of the country.

REGIONAL DIFFERENCES Although milk is produced nearly everywhere in the United States, the organization of its production varies greatly, as is evident in Chart 125. In the South Atlantic states, from 81 to 92 per cent of the farms with cows have only 1 or 2; that is, they are producing milk almost solely for the use of the family. Nearly all the remaining farms have from 3 to 9 cows. On most of these farms, the dairy enterprise is supplementary to the other main enterprise of cotton and/

or tobacco, or truck crops and the like. Around the cities are a few, however, which are primarily dairy farms. Northward into the border states of Virginia to Kentucky, and westward to Missouri and Texas, the proportion of farms in the second group increases gradually, and a few more

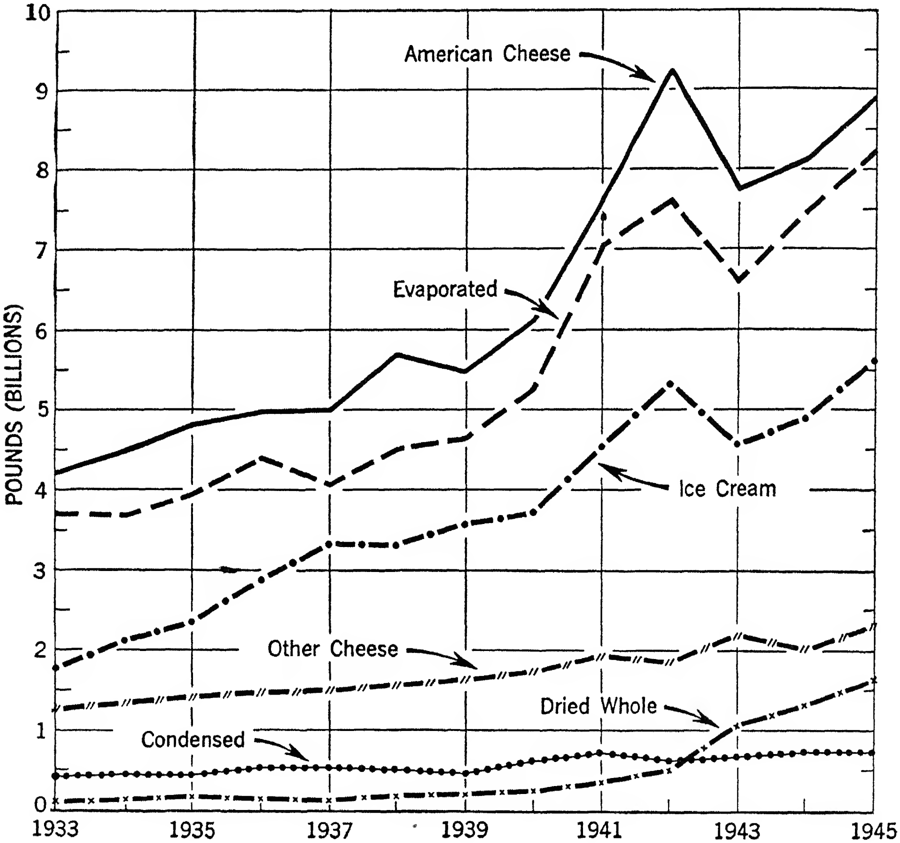

CHART 122C. Utilization of milk in manufactured whole milk products, United States, 1933–1945. (Milk equivalent)

larger herds appear. The strictly dairy states, Wisconsin and Vermont, have the largest fraction of their herds in the third group, 10 to 19 cows, and New York comes close to this. The states with the largest proportion of their herds of more than 20 cows are Vermont and the three southern New England states, New York, New Jersey, Wisconsin, and California. The other Western states have most of their herds in the 3–to–9 group, but several of them have a goodly number in the 10–to–19 group.

The major differences between the commercial dairy farms of the dif-

ferent parts of the country are best revealed in terms of the 606,000 farms classified as dairy in the 1930 census. Table 92 presents the regional differences in terms of averages for typical states. Net receipts from all sources per cow were higher in Wisconsin than in Vermont because the Wisconsin dairy farmers sold more hogs and poultry, but also because they bought less feed and had larger production per cow. California had the highest feed bills, and Massachusetts and Texas next. California and Massachusetts hired the most labor. California and Wisconsin led in production per cow. In net receipts per cow, South Carolina stood at

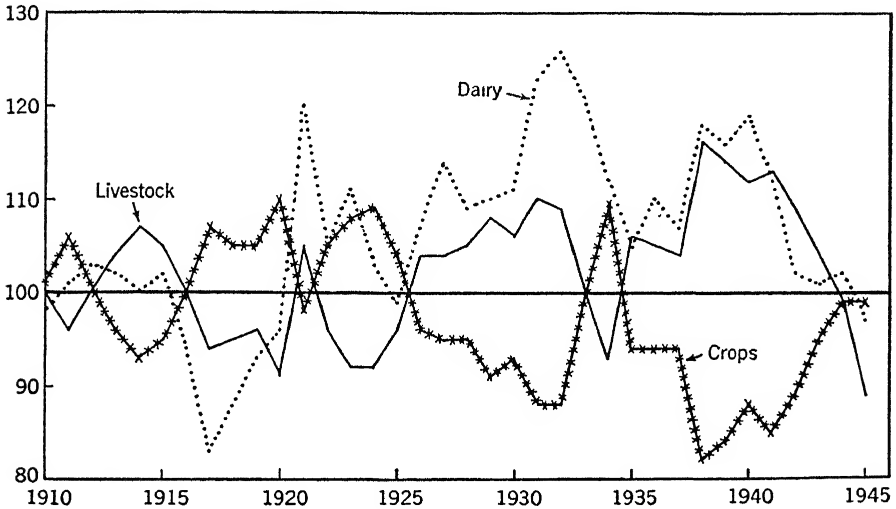

CHART 123. Index numbers of prices of dairy products expressed as departure above and below the index numbers of all farm products; similarly for the index number prices of all crops and of all livestock and livestock products. (1910–1914 = 100.)

the top, with Iowa second, mainly because of larger receipts from other sources. These were all dairy farms in the sense that dairying was their most important enterprise, but the South Carolina farms could still have grown considerable cotton.

The dominant dairy breed in most city milksheds outside of the South is Holstein. Guernsey or Jersey herds in such milksheds usually produce premium grades of milk. Some high-testing herds, or parts of herds, may be needed, however, to keep the butterfat test up to the legal minimum, which ranges from 3.5 to 3.8 per cent in most Northern and Western cities. Guernsey and Jersey herds may also be found in the cream zone just outside the milk zone. A few Ayrshire herds are also found in the

outer borders of the Northeastern milkshed. Jersey cattle are commonest in the South. The fluid milk delivered in most Southern cities tests from 4.0 to 4.5 per cent. Most cheese production also favors low-testing Holstein milk. Some herds in cheese areas test as low as 3.2 per cent. Of the pure-bred dairy-breed bulls registered in 1941, 40 per cent were Holstein, 25 per cent, Guernsey; 20 per cent, Jersey; 7 per cent, Brown Swiss; and 5 per cent, Ayrshire.

TABLE 92. MAJOR FACTS CONCERNING THE FARMS CLASSED AS DAIRY FARMS IN THE 1930 CENSUS

	Massachusetts	*Vermont*	*New York*	*Wisconsin*	*Iowa*	*Kansas*
Percentage of dairy farms	30.4	57.9	42.6	69.0	5.9	4.0
Milk cows per farm	12.0	15.6	14.2	12.3	11.5	10.7
Other dairy animals per farm	8.6	12.9	12.1	11.1	13.3	20.0
Production per cow (gal.) [a]	654.0	544.0	644.0	664.0	499.0	451.0
Percentage of income from livestock products [b]	76.0	68.0	71.0	61.0	55.0	66.0
Gross farm receipts	$4,235	$2,905	$3,285	$2,448	$2,750	$2,380
Expenditures — total [c]	2,520	1,094	1,312	576	683	889
Purchased feed	1,420	658	798	233	309	516
Purchased fertilizer	113	54	78	54	64	53
Hired labor	987	382	436	289	310	320
Net farm receipts from all sources [d]	$1,715	$1,811	$1,973	$1,872	$2,067	$1,491
Gross receipts per milk cow	$353	$186	$231	$199	$239	$222
Feed bill per cow	118	42	56	19	27	48
Net receipts from all sources per cow [d]	$143	$116	$139	$152	$180	$139

RATIONS FED TO MILK COWS A survey made by the Bureau of Agricultural Economics in 1944 showed that corn then made up 31 per cent of the ration fed milk cows; commercial mixed dairy feeds, 27 per cent; oats, 18 per cent; oilseeds, oatmeal, and gluten, 8.4 per cent; barley, 4.5 per cent; wheat bran and shorts, 4.3 per cent; and wheat, 3.3 per cent.[2] As compared with the prewar, this represented a big increase in the use of commercial mixed feeds, in place mainly of oats, barley, and wheat and oilseed by-products. With feed scarce, the commercial mixers were in the best position to assemble and combine odd lots of grains and by-products. The West North Central states had grown 72 per cent

[2] This discussion is based on *Rations Fed to Milk Cows*, by John L. Wilson, Bureau of Agricultural Economics, January, 1945.

of their concentrate rations on their own farms; the East North Central states, 64 per cent; and the North Atlantic states, only 15 per cent. The parallel figures for commercial mixed feeds were 7, 11, and 72. What the Midwest dairymen do not grow themselves, they mainly buy in the form of bran, shorts, oil meal, and the like. The South Atlantic states were using 52 per cent of commercial mixed rations; the South Central states, 24 per cent; and the Western states, 40 per cent.

TABLE 92. MAJOR FACTS CONCERNING THE FARMS CLASSED AS DAIRY FARMS IN THE 1930 CENSUS. (*Continued*)

	Montana	*California*	*Oregon*	*Tennessee*	*South Carolina*	*Texas*
Percentage of dairy farms	4.6	11 2	14.8	2.4	6.4	1.6
Milk cows per farm	13.1	28.8	11.9	12.0	12.3	19.1
Other dairy animals per farm	17.3	25.9	12.5	12.1	12.7	19.8
Production per cow (gal.) [a]	504.0	755.0	602.0	411.0	400.0	408.0
Percentage of income from livestock products [b]	68.0	80.0	67.0	66 0	76.9	79.0
Gross farm receipts	$2,875	$6,100	$2,650	$2,440	$3,970	$3,648
Expenditures — total [c]	1,111	3,009	871	944	1,513	1,887
Purchased feed	559	1,662	476	568	1,230	1,255
Purchased fertilizer	46	87	54	59	208	78
Hired labor	506	1,260	341	317	75	554
Net farm receipts from all sources [d]	$1,764	$3,091	$1,779	$1,496	$2,457	$1,761
Gross receipts per milk cow	$219	$212	$223	$203	$323	$191
Feed bill per cow	43	58	40	47	100	66
Net receipts from all sources per cow [d]	$135	$107	$150	$125	$200	$92

[a] Data are not available as to difference in butterfat test. More of the cows in the South are of high-testing breeds.
[b] Includes income from eggs and wool also — data not available for dairy products only.
[c] Data available only for the three items — feed, fertilizer, and labor.
[d] Net with only three expense items deducted.

The dairymen were feeding an average of 1,460 pounds of concentrates per cow in 1944, the range being from 2,470 in New Jersey and 1,890 in all the North Atlantic states, to less than 1,000 in several Western states which rely upon alfalfa largely, and 1,000 to 1,200 in the Southern states producing mostly for home use.

The difference in sources of feed affects greatly the cost of the rations. If the home-grown feeds fed in 1944 were valued at what the farmer

would get for *them* if he sold them, the values of the concentrate rations varied as indicated in Chart 126, from under \$2.00 in western Iowa to over \$3.25 in Florida and Aroostook County, Maine. The average for the United States was \$2.61; for the whole-milk areas, \$2.74; for the butterfat areas, \$2.39. Of course, all these values were at wartime peaks in 1944. The 1939 value comparable with the \$2.61 was only \$1.22; the 1932 value, \$.86; the 1922–1941 average, \$1.52. The values are low in

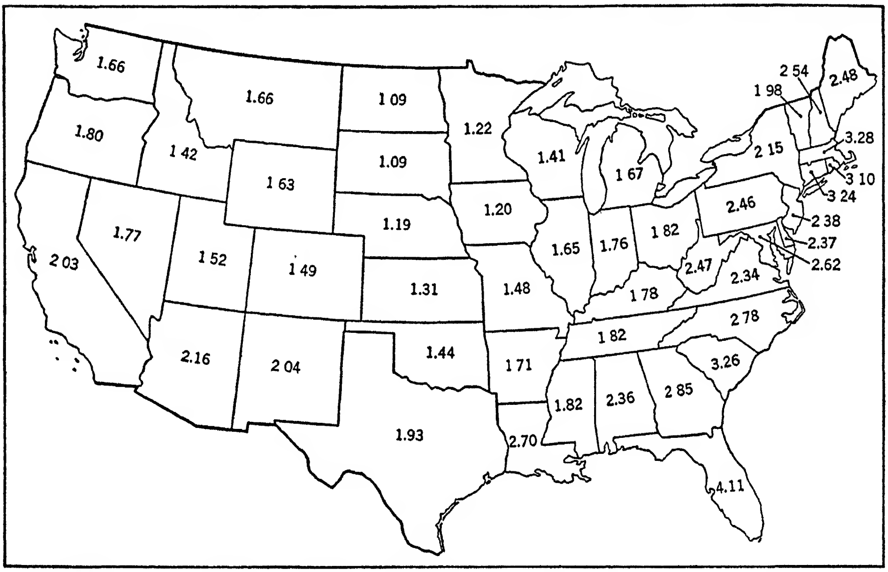

CHART 124. Average prices per hundredweight of milk received by farms for all dairy products sold by farmers in 1940.

the western Corn Belt because of the general use of home-produced feeds which are low in price there because of distances to markets and likewise in the Northern Great Plains.

When these feed prices are matched with the prices of dairy products shown in Chart 124, the milk-feed price ratios (pounds of feed which one pound of milk will buy) are lowest in the North Atlantic states at 1.15 for the 1922–1941 average; and highest in the West North Central states at 1.57. They are relatively low in the East North Central states and in the West at 1.25 and high in the South. The butterfat-feed price ratios have a somewhat different pattern — relatively low in the South, because of the low butter prices prevailing there, and relatively high in the East North Central states because the processing and marketing of butter are so well developed in that region.

METHODS OF DETERMINING ECONOMICAL FEEDING Chapters IX and XI explained procedures for determining the most advantageous rate of feeding, and composition of rations, under two sets of conditions; one, where all the feed is bought; and two, where very little of it is bought. Other procedures than these, however, are frequently employed in farm management studies. One of these is that employed by Nodland and Pond in an analysis of 1,462 yearly records of dairy farms.[3] These farms were

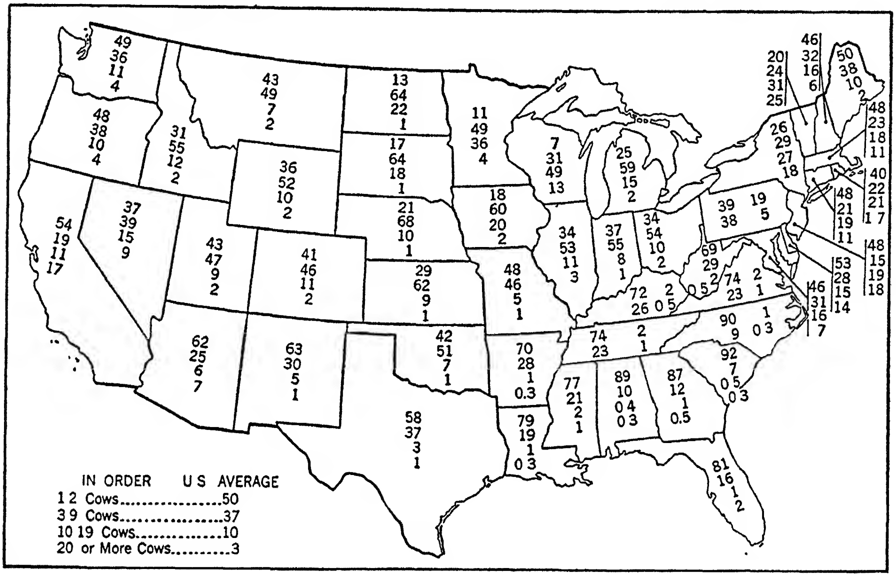

CHART 125. Percentage of farms with cows in four groups according to number; by states, 1940.

grouped according to amounts of feed fed measured in T D N's, excluding pasture feed, and the average production per cow and return over feed cost computed, pasture being charged at $1 per month per cow.

The procedure followed in some of the analyses of feeding records of herd-improvement associations is to compute, from the Morrison standards, the T D N's required for maintenance plus production, and the T D N's supplied by the feed fed, and assign the difference to the pasture. The T D N's may be converted to legume-hay equivalents so as to make them more meaningful to farmers. The South Carolina herd improvement records for 1937–1941, handled in this way, show 12,030 pounds of legume-hay equivalent required for the 6,930 pounds of 4 per cent

[3] T. R. Nodland and G. A. Pond, *Managing the Dairy Herd for Greater Returns*, Minnesota Bull. 378, 1944.

milk per cow, of which 9,470 was supplied by feed fed and 2,560 by pasture.[4] The maintenance ration of these cows was 6,640 pounds. According to these estimates, in the 232 days which they were on pasture, they averaged only 11 pounds per day of legume-hay equivalent from pasture out of 33 pounds of feed required. When the feed fed was valued at farm prices, it cost 86 cents per hundredweight of hay equivalent. At the values assigned to the pasture land, the pasture feed cost only

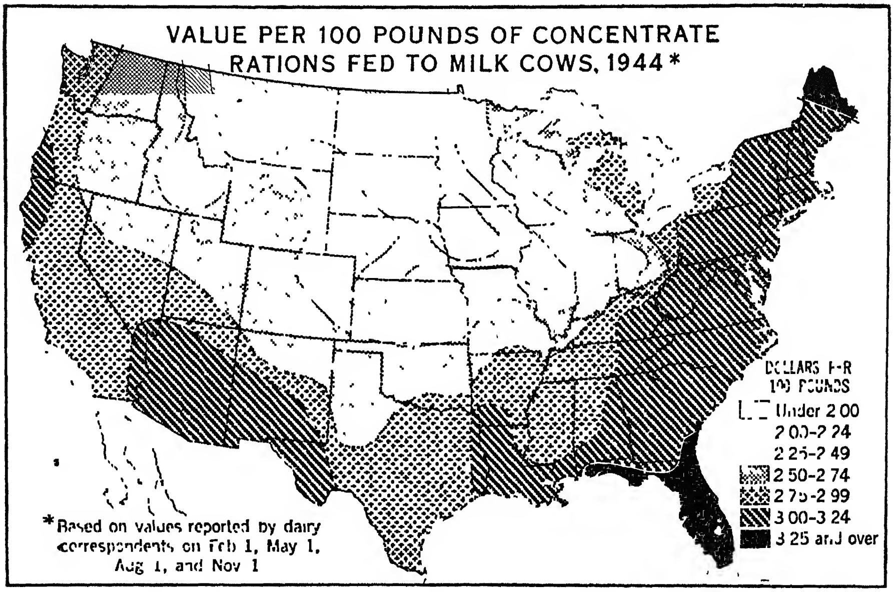

CHART 126. Value of concentrate rations fed milk cows, 1944. (John L. Wilson, *op. cit.*, p. 8)

26 cents per hundredweight.[5] Surely this represents undervaluation of the pasture.

When these records are examined in more detail in Table 93, it appears that some of the cows obtained less than nothing from pasture, although they were on pasture for several months. This reflects the general tendency to assign too high values to feed fed and not allow sufficiently for poor quality and waste. It does not seem at all likely that the cows in the herds fed heavy grain rations in the two groups obtained so little pasture feed as the table indicates; nor, contrariwise, that the light-fed cows received so much. In the analysis, the pasture costs are not figured in the feed costs, and in consequence their undervaluation

[4] Mimeographed report supplied by the South Carolina Agricultural Extension Service.
[5] Also see discussion of this subject in *The Cost of Pasture*, Cornell A. E. 356, 1941.

does not affect the net returns over feed. But the assigning of too high T D N values to the feed fed does make some of the cows show low returns.

TABLE 93. PRODUCTION AND FEED RECORDS OF TWO GROUPS OF COWS, ONE HERD LIGHT PRODUCERS AND THE OTHER HEAVY, FROM THE SOUTH CAROLINA DAIRY HERD IMPROVEMENT ASSOCIATION RECORDS. FEED MEASURED IN *legume-hay* EQUIVALENTS

	Milk produced	*Feed required*	*Supplied by pasture*	*Days on pasture*	*Returns over feed cost*
Cows producing 4,000–5,000 pounds of milk:					
Grain fed:					
Under 1,500	4,900	9,530	4,890	247	$57.20
1,500–2,000	5,090	10,290	3,190	262	75.90
2,000–2,500	5,150	10,030	2,410	247	71.90
2,500–3,000	5,130	10,010	1,830	222	68.70
3,000–3,500	5,120	10,010	680	224	62.50
3,500–4,000	5,247	10,410	− 9	135	55.70
Cows producing 8,000–9,000 pounds of milk:					
Grain fed·					
Under 2,500	8,390	13,150	4,480	314	$152 90
2,500–3,000	8,410	13,490	3,760	270	152 20
3,000–3,500	8,790	13,777	3,280	255	154.30
3,500–4,000	8,810	13,490	2,280	205	150 00
4,000–4,500	8,970	13,617	1,660	188	142.90
4,500–5,000	8,770	13,760	430	157	139.58

Nodland and Pond's analysis of proportions of the rations obtained from concentrates and roughage, and likewise that for proteins in the rations, gave results that varied in the right direction, but one has no way of knowing whether the amount of the variation was too much or too little. Certainly the amount of nutrient obtained from pasture influences strongly the amount that can be supplied to advantage in other forms. Whether the pasture includes white clover, ladino clover, or alfalfa is also highly important. Only by obtaining data on the relation of specific pasture practices to the amounts of concentrate and roughage, and of protein in these, that must be fed in order to obtain given milk outputs, can one forecast the effect of these on the receipts and expenses and net farm income.

SIZE OF THE DAIRY ENTERPRISE Similarly, the method of determining the balance of enterprises, and in particular the size of the dairy enterprise, which is outlined in Chapters XI, XIII, and XIV, is by no

means always employed in analysis of this problem. Another method is to estimate net returns per hour, or per productive man-work unit, from the several enterprises on one farm, or in the area. The limitations of this method have been pointed out elsewhere.[6] Our concern here is to point out that this method usually shows the dairy enterprise at a disadvantage. Thus F. A. Harper summarizes twenty-seven years of results of analyses in these terms of New York farming by the following comparison of returns per hour of labor: dairy cows, 27 cents; hens, 44 cents; apples, 59 cents; potatoes, 58 cents.[7] Similar results could be obtained in many other states. Such results indicate strongly that the dairy enterprise should be reduced, or better still, eliminated altogether. Yet it is doubtful if on most of the dairy farms in New York State any other better-paying use of the time spent on the dairy herd could be found, or if the farm income could be increased by expanding any other enterprise at the expense of dairying. No doubt some farms would gain by shifting over to poultry or apples altogether; but on most of them, some combination with dairying pays best, because the dairy and other enterprises use labor largely at different times and also together provide for fuller use of the land.

Even greater difficulties arise when the results of such analysis are expressed in terms of costs per unit of product to be matched against selling prices, since in this case a specific value must be placed on the labor used at different seasons, and at chore work and field work, and also on the relative value of family, proprietor, and hired labor; for, if these values are not differentiated, the dairy enterprise is pretty certain to appear at the same disadvantage as appears in the figures on return per hour.

As made evident in Chart 120, the general trend is toward more dairy farming. Except in certain periods and in most areas, the farming improves and farm incomes and land values rise as an area shifts to more dairy farming. Therefore any figures in terms of returns per hour, or unit costs and profits, that make dairying appear disadvantageous, must be scrutinized carefully.

TIME OF FRESHENING The question of the time of freshening of cows can also be analyzed in several ways. One of these is to group the herds according to the percentage of the cows freshening in the fall or spring, as in Table 94 taken from the Nodland-Pond Minnesota study. Almost always the production per cow increases as in this table. Not only do

[6] See p. 232.

[7] F. A. Harper, *Trends of Returns for Labor on Farm Enterprises in New York*, Cornell Monograph A. E. 172, 1937.

cows freshening in the fall commonly produce more milk in a year than those freshening in the spring, but usually the farmers emphasizing winter production are the better dairymen and have the better cows If dairy farmers made up fully for the shortness of their pastures in late summer by feeding a well-balanced ration with plenty of succulent forage, they would get as high production over the year from spring-freshened as from fall-freshened cows. Only a small fraction of the farmers, mostly those operating close to cities, have pretty well learned how to do this. Lacking this skill, they play safer to have the short pastures coincide with the period when the cows are dry and need little more than a maintenance ration.

Although in the Minnesota analyses the herds mostly freshening in the fall were on pasture only slightly less than those mostly freshening at other seasons, they must have obtained more feed from pasture; otherwise the T D N's per pound of butterfat would have been lower, since cows in light production have the higher T D N inputs per pound of output, so much of the feed going into maintenance. The low rates charged for this extra pasture feed may, therefore, have made the spring-freshened herds appear to less disadvantage than they really were. Still, we do not know which time of freshening would have paid best if the fall- and spring-freshened herds had been equally well fed.

TABLE 94. PRODUCTION, FEED INPUT, AND RETURNS OVER FEED COST FROM MINNESOTA HERDS GROUPED ACCORDING TO TIME OF FRESHENING, 1928 TO 1937

Per cent fall freshening Range	Average	*Number farms*	*Butter-fat per cow*	*T D N per cow*	*T D N per lb. butter-fat*	*Index of feed cost per lb. butter-fat*	*Months on pasture*	*Return over feed cost per cow*
29 9 and less	16.8	206	217	3,964	18.7	100 0	5.1	$37 32
30.0–49.9	39.6	308	232	4,213	18.4	100.2	5.1	40.14
50.0–69.9	58.9	433	243	4,289	18.0	99.0	5.0	42.28
70.0–89.9	78.8	376	246	4,452	18.4	100.4	5.0	42.07
90 0 and more	95.5	139	258	4,719	18.8	102.3	4.9	43.08

Source: *Op. cit.*, p. 10.

Maximum production, however, is not the only consideration. The fall-freshened cows must have more winter feed grown for them and stored, and they require more labor. Spring-freshened cows feed themselves during the months while they are in heavy flow. All these factors

need to be considered as well as milk flow. The statistical procedures used in constructing tables like Table 94 usually give answers that are in the right direction, but they may not approximate the amount of advantage at all closely, especially if the pasture feed is undervalued.

Another method of analysis is to attempt to compare the cost of production by seasons. As this method is commonly used, the herds freshening in the spring have very low spring and summer costs, because the cattle are in heavy flow while getting cheap pasture feed, and very high costs in the winter because the cows must be barn-fed while in light production. The fall-freshening herds, on the other hand, have heavy flow while the cows are being barn-fed, a fairly heavy flow in the early summer while the feed is cheap, and a light flow in late summer while the feed is short. If the pasture feed costs in this second case are properly distributed, the resulting feed costs may not be far from the true figures. If the area has both kinds of herds, however, the seasonal average costs for all herds combined are likely to be biased in favor of spring freshening. The unit costs may still be lower in the winter, but if so it is because other factors, such as heavier feeding and better care, offset the biases.

If the unit-cost method is to be used in trying to arrive at an answer to the question, the safest procedure is to figure the costs of the maintenance and production rations separately month by month, to charge the maintenance ration as a rate per hundredweight of milk produced, or per pound of butterfat, and the production ration as fed month by month. In this way, the heavy production will pay its share of the maintenance of the cows while they are dry or nearly so.

The most direct procedure of answering the question of the best time for having a herd freshen is to compare expected receipts and expenses and net incomes from the herd when freshening according to several schedules. For such estimates, data are needed on production by months with the different schedules, prices received by months, prices of the different purchased feeds by months, and any other out-of-pocket costs. Over the years from 1930 to 1939, prices of milk and of butterfat were a fifth higher in December than in June, and condensery prices 17 per cent higher. The extra labor of caring for a herd in full milk in the winter needs to be weighed by the farmer, but he will not be helped in arriving at a wise decision simply by assigning an arbitrary value to the part of it which he or his boys perform. The cost of any extra hired labor involved can be approximated rather closely.

SUPPLYING CITY MILK MARKETS The question of time of freshening becomes particularly important in city milksheds. Consumption of fresh

milk is almost even over the year. In most milksheds, however, more of the cows freshen in the late winter and early spring than in the fall, with the result that the supply of milk is low from September to January, and if there is milk enough for these months, there is a large surplus from April to July, and especially in May and June. The surplus can be sold as fresh cream, but fresh cream consumption is also fairly even over the year, so that if there is cream enough for the fall months, there is a surplus in the spring. This surplus can to a limited extent be used in ice cream, which has a summer peak, but most of it must be used in butter, cheese, or evaporated milk, the processing plants for which are more or less adjusted to uneven receipts. If the milkshed does not provide enough cream in the fall months, as is true of the Boston and most other large Eastern milksheds, some must be shipped in from the Midwest, and the tendency is to contract for such cream on a year-round basis. Thus a market may be buying Midwest cream and making butter at the same time.

Under these circumstances, the price in a city milkshed of any milk not used as fluid milk — ordinarily called Class II milk — even though that use is in fresh cream, must follow closely the price paid for milk used in making butter, cheese, or evaporated milk. In a milkshed in an intensive dairy area, like that of Chicago, Milwaukee, or Minneapolis-St. Paul, the price of Class II milk will be the same as the price of milk used in the processing plants, plus the cost of any extra care that fresh milk may require, plus some allowance for the skim milk if the competition is with plants making butter. In a cream-deficit milkshed, like that of Boston, it will be the price of cream in some market like Chicago, plus the cost of transporting the cream to Boston, and the Chicago cream price will be the price of the milk used in country plants in making butter, cheese, or evaporated milk, plus the cost of shipping fresh cream to Chicago.

The price of Class I milk, in turn, if the price is on a truly competitive basis, is what must be paid to take it away from Class II uses, plus the cost of transporting it as fresh milk from the outer limits of the fresh-milk zone. Chart 127 shows how the milk, cream, and butter zones develop around a city. No. 1 is the ideal arrangement that would develop if the territory were perfectly uniform and the milk, cream, and butter were all transported over beelines. No. 2 illustrates the forms that the zones may take under actual conditions. The railway lines run nearer to some parts of the area than to others. Also, territory nearer to market may ship by truck and that farther out, in glass-lined tank cars. Also because of long local hauls, a butter plant may be found nestled in some

valley in the mountains within 100 miles of the market while milk is being shipped from an intensive dairy area 200 miles out.

Accompanying such a system of zones is a structure of prices which determines the boundary of the zones. If we assume uniform conditions over the milkshed and pure competition, the structure of prices would be that indicated by Chart 128, given a price of $2.00 per hundredweight for milk delivered to city plants. The fluid milk zone is assumed to have a radius of 200 miles. With transportation costs of $\frac{1}{4}$ of a cent per hundredweight-mile, the producers at the outer boundary of this zone will receive $1.56 net. With transportation rates for cream at 1/32 of

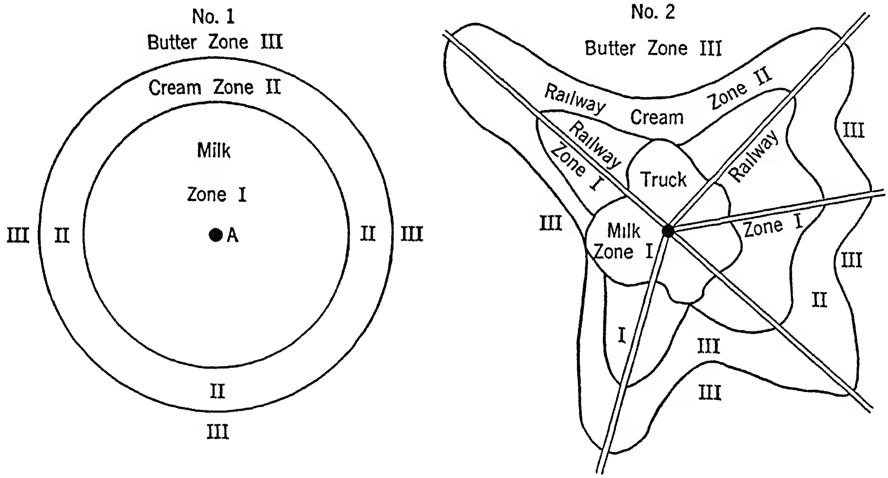

CHART 127. Ideal and modified systems of milk, cream, and butter zones around a city. (Reproduced from John D. Black, *The Dairy Industry and the AAA*, Brookings Institution, Washington, 1935, p. 154.)

a cent per hundredweight-mile, any producer in Zone II would lose by shipping milk. Similarly, any producers in Zone III would lose by shipping cream, since butter transport costs only 1/96 of a cent per hundredweight-mile. Irregularities in the shape of the milkshed such as indicated in No. 2 in Chart 127, do not seriously distort the price relationships between the zones.

It also follows from the foregoing that if the market was strictly competitive, Zone I would narrow in the spring and summer and widen in the fall and winter, and the prices at the city and at the farm would change with the changing length of haul. In practice, milk dealers do not like to vary their retail prices, and hence their prices to producers; and once a producer equips himself to deliver fresh milk in the fall, he

likes to continue it the year round. Hence, the Zone I's tend to be large enough to supply enough even for the fall months. They therefore have varying surpluses over the rest of the year.

The Zone I boundary is often expanded even further to include areas whose supplies are not really needed, but which are in position to be used as clubs by some of the dealers to beat down the price to producers. To check this, the producer cooperative may extend its membership to

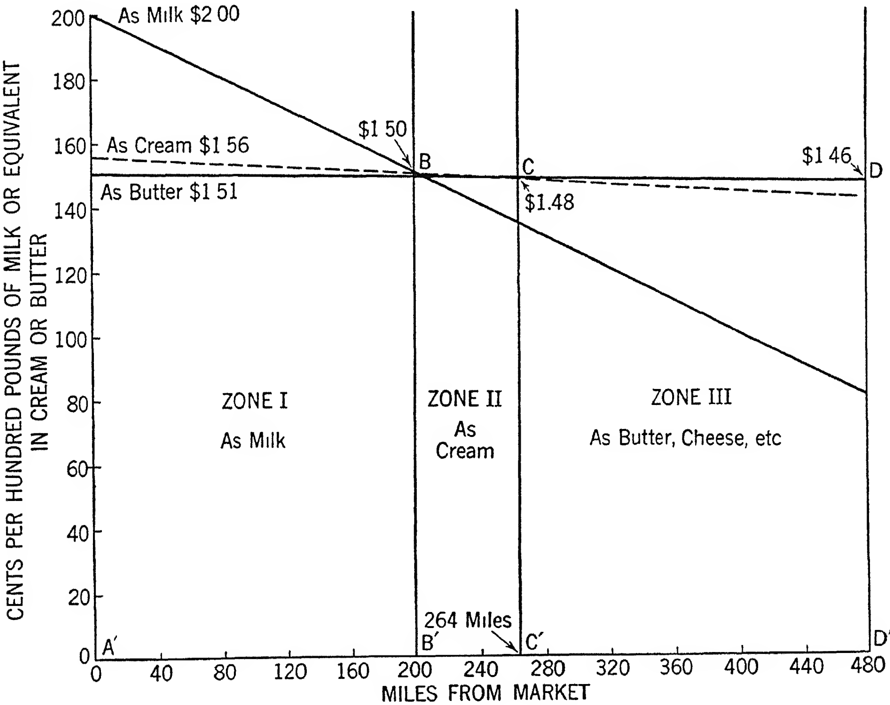

CHART 128. Structure of dairy-product prices within a milkshed. (Idealized.) (Reproduced from John D. Black, *op. cit.*, p. 160.)

include these outlying areas. The market may therefore find itself with a surplus of 15 to 40 per cent even in the short season. Under these circumstances, the producers nearer the city find themselves selling a larger share of their milk at Class II prices than before. If they do this willingly, it is in the hope that the cooperatives, by controlling all potential supplies, can drive a better bargain with the dealers and get a better Class I price. In this hope, they may easily be disappointed. The larger supplies of milk available may even weaken their bargaining position. Some of the larger producer cooperatives, hoping to gain in this way, have subsequently been forced to contract their milksheds in order to meet the

competition of dealers and producers staying out of the pool. Others have met this situation by bringing the market under federal control, thus forcing all dealers and producers to join the pool. The federal administrators under such circumstances need to see that too much territory is not included within the pool, or to work out some arrangement under which the inner-zone producers receive enough higher Class I prices to compensate them for allowing the producers outside the normal Zone I to share in the fluid-milk market.

Table 95 shows the effect on the "blended" or average prices of adding territory which supplies an excess of from 22 to 33 per cent of milk in different months. The excess of 10 per cent in the normal Zone I is needed to take care of day-to-day fluctuations in consumption and excess milk carried and returned by delivery wagons. In the Northeast, at least, territory distant from market usually has more uneven production than that close to market. The Class I price is assumed to be the same in either case and uniform over the year. The blended price is reduced 15 cents per hundredweight by taking in this extra territory. The cooperative must be in a strong bargaining position if it can force the Class I price this much above $2.50 per hundredweight. If it does, the dealers will need to collect this much more from the consumers or reduce their

TABLE 95. EFFECT ON BLENDED PRICES OF ENLARGING A MILKSHED TO INCLUDE AN EXTRA SUPPLY OF MILK

	Class I delivered price	*Class II delivered price*	*Normal Zone I*		*Enlarged Zone I*	
			Deliveries as percentages of fluid milk sales	*Blended price*	*Deliveries as percentages of fluid milk sales*	*Blended price*
January	$2.50	$1.58	120	$2.35	145	$2.21
February	2.50	1.55	126	2.30	151	2.18
March	2.50	1.46	134	2.24	163	2.10
April	2.50	1.38	145	2.15	174	2.02
May	2.50	1.32	156	2.07	187	1.95
June	2.50	1.30	160	2.05	193	1.92
July	2.50	1.33	148	2.12	164	2.04
August	2.50	1.36	126	2.27	154	2.12
September	2.50	1.40	112	2.38	134	2.22
October	2.50	1.45	110	2.40	132	2.25
November	2.50	1.52	112	2.39	134	2.25
December	2.50	1.55	116	2.37	139	2.23
Average	2.50	1.42	130	2.25	156	2.10

earnings. A much sounder program for the cooperatives will be to handle the milk produced outside of normal Zone I in a separate pool, and convert it to cream, butter, cheese, or evaporated milk in local up-country plants.

It should now be evident that the dairymen in milksheds are confronted by difficult selling problems. Often they must make decisions as to whether to deliver their milk to a country milk or cream receiving station or to a butter plant or to some other local processing plant, or as to whether to sell through a cooperative or to an independent dealer. If they join a cooperative, they need to be able to vote right on its policies and management. The foregoing analysis should help in making such decisions, but of course it cannot alone furnish the answer in any particular situation.

VOLUME OF OUTPUT IN A MILKSHED

It should also be apparent that the relation of volume to prices takes a special form in such a milkshed as described. It may affect the Class I price directly, but usually its effect is mainly on the blended price. Any one ordinary producer can, of course, increase his output without visibly affecting the blended price; but the circumstances that cause one producer to do this are likely to affect numbers of them. And if the market is operating on a base-rating plan so that each producer has his own Class I quota or base, his own blended price will be reduced as he expands his production. If a producer, under this plan, has out-of-pocket costs of $1.75 per hundredweight obviously he can afford to produce none whatever at the Class II price of $1.42 in Table 95. He will keep as close to 100 per cent of fluid-milk sales as possible, supplying less more often than more. If, however, his genuine out-of-pocket prime costs — for purchased and readily merchantable home-produced feed and the like — are only $1.00 per hundredweight, he will still have a short-run margin of 42 cents for his Class II milk, and will add to his net cash income by producing some Class II milk. In the pasture season, his margins over cash costs will of course be still larger.

In practice, such a farmer is likely to watch his blended price more closely than his Class II price. If by much heavier feeding, he increases his output by 20 per cent per cow, his blended price will fall to $2.14. Suppose, however, that this heavier feeding is more efficient, so that 6 per cent fewer T D N's are needed per unit of output. Feed costs have decreased 6 per cent per hundredweight while prices have decreased only 5 per cent. The decline in price with the larger output, will, never-

theless, bring the highest-profit point earlier than if the price were not affected by the supply.

If the market is operating on a pooling basis, and all the farmers respond to prices as if they were one, the result will be about the same as if a base-rating plan were in effect. As long as only a few of them increase their output, however, the highest-profit analysis of Chapter XVII applies.

COMPETITION WITH OTHER AREAS

Dairy farming involves long-term investments. Producers in established areas therefore need to look ahead and see what the prospect is for prosperous dairying in their areas. Some areas now working into dairying need to analyze their opportunities to see how far they can expect to go in competition with the older areas. The question which they all need answered is best formulated as follows: *How much milk can we advantageously produce in our area at different levels of relative prices that may prevail?* If, for example, the answer is that at a level of $2.00 per hundredweight for 4 per cent milk, they cannot afford to expand their dairy enterprises, because other enterprises will contribute more to their farm incomes, and some other areas can afford to do so, they should not undertake to expand their dairy operations.

The general principles involved in arriving at an answer to this question were presented in Chapter XVI. A chart was included there which shows how five areas competing for Northeastern markets are likely to expand or contract their production at three levels of prices.[8]

The information and analysis needed on this subject cannot be assembled by individual farmers in one area. Public agencies need to collect the data and make it available to their farmers. Such data should as a minimum include the following:[9]

1. Trends in production in all the competing areas.
2. Prices being received by producers in the competing areas.
3. Relative changes in land values and cash rents in the competing areas. These show to what extent the farmers are prospering under the changes developing. Data on wages being paid are somewhat useful in the same way.
4. Transportation costs and prices being received in common markets. These latter, among other things, show market preferences for the products of different areas.

[8] See p. 383.

[9] W. F. Finner and Ronald L. Mighell, *Trends in Dairying by Major Type-of-Farming Regions*, U.S.D.A. Tech. Bull 751, 1941.

While the foregoing data will not give any final answer in one figure or curve, they will go a long way toward helping the producers to arrive at sound conclusions.

Further data should be of the sort that will enable economists to determine the place of the dairy enterprise in the systems of farming in the competing areas: data that they can put into operating statements or budgets to discover whether enlarging the dairy enterprise will increase or decrease the net farm incomes at different levels of prices that may come to prevail; or that may point the direction in which the dairy enterprise will fare best — summer versus winter production, cheese versus butter versus evaporated milk, etc., main versus supplementary enterprise, home-produced forage and feed versus sizable purchases of concentrates, etc. Such data can be formalized into supply curves such as Chart 56, but these will be of value mainly to professional analysts.

Formalizing data of the foregoing sorts into unit costs of production would be helpful if the unit costs were dependable. Unfortunately, as pointed out in Chapter XXI, to obtain dependable unit costs for a dairy enterprise which is one of two or three on a farm is a very complex operation, and some difficult problems of evaluation arise even on farms where dairying provides so large a part of the farm income that the rest can be handled as by-product credit. On a diversified farm including dairying, the charges for the use of the land must be distributed between permanent and rotation pasture, and between pasture and other crops grown in rotation; also, the labor rates per hour must be varied between chore and field work, between work done at different seasons of the year, and between hired and unpaid family labor; likewise, the hourly rates for horse and tractor work. Charging home-produced feed at what it could be sold for does not fit silage, straw, and the like, and even in the case of hay and grains may misrepresent the facts of the situation because the only reason for their being produced is to serve the dairy enterprise. Allowances for skim milk and manure need to be in terms of what they really contribute to the net farm income, which is usually much more than ordinarily assumed. It should also be apparent that the distribution of labor rates between dairy work and other work will be very different on farms in which dairying is combined with corn and hogs than on a farm in which it is combined with tobacco, potatoes, poultry, or cash grain; and similarly for horse and tractor rates.

Unless the unit costs are worked out in these terms, they will mislead and not point in the right direction.

It should always be kept in mind that if the unit costs were correctly

estimated, *all that they would show is the differences in costs of transportation to the common market, plus the effects of differing amounts of maladjustment between prices of the product and rents, wages, and other cost-rates in the competing areas, and of other forms or types of maladjustment.*

Attempts have been made to determine how much milk an area will produce at different levels of price by analyzing the relation between past production and past prices. S. M. Johnson, after reviewing these attempts, and testing them out with Vermont data, has concluded as follows: "Cow numbers in Vermont from 1924 through 1938 were not closely associated with any of the price factors in preceding periods with which they were compared. . . . Thirty per cent of the variation in receipts per cow in the crop years from 1924 through 1938 was associated with variation in annual milk-feed ratios . . . and in pasture conditions in corresponding crop years." [10] Thirty per cent is not a very significant part of the variation. Furthermore, these are only short-run responses. Not until prices have remained on a given level long enough to make farmers believe that they will remain there are farmers likely to make the adjustments justified by the changes.

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[10] S. M. Johnson, *Elasticity of Supply of Milk from Vermont Plants, III. Forecasting the Milk Supply*, Vermont Bull. 480, 1942, p. 101.

CHAPTER XLIII

Poultry Farming

THE MANAGEMENT PROBLEMS OF POULTRY PRODUCTION HAVE RECEIVED little or no attention in earlier chapters. Around 85 per cent of the farms of the United States reported some poultry in 1940; but on most of these farms the poultry is a minor enterprise and does not conflict importantly with any of the principal enterprises. The specialized poultry farms, at the same time, are highly specialized. They come as near to being "food factories" as any farms in this country, resembling in this respect the dry-lot milk-producing farms discussed in Chapter IX. They buy practically all their feed and many of them buy their replacements in the form of baby chicks. This chapter will deal only briefly with the management problems arising from combining poultry with other lines of production. Most of the analysis will relate to specialized poultry farms.

It is well at the start to define the different types of farms engaging in poultry production. It is not enough simply to classify them as specialized (or commercial) and as nonspecialized. If Class A is specialized poultry farms, the rest should be classified as: B, combination types of farming in which poultry is one of two or more major sources of income, the other sources commonly being dairying, fruits, vegetables, or perhaps cotton or tobacco in the South; C, farms in which eggs and poultry are produced for the market, but only as a minor enterprise — this description fits most of the Midwest poultry production; D, poultry production largely or wholly for the use of the farm family; E, poultry production on farms classified as "part-time" in the census; and F, backyard flock production in small towns and suburbs.

The classification needs to be related to the census data on sizes of poultry flocks in Table 96. The 3,016,000 farms with under 50 chickens on April 1, 1940, belong in Classes D and E. Over half of these had less than 25 chickens. The groups that most nearly fit Class C are the 100–199 group of 735,800 farms, although in the South some of these are really Class B farms, and the group next smaller with 50 to 99 chickens. The Class B farms in the North and West are partly in the 200–

399 group, and partly in the 400–699 group; and the Class A are specialized farms mostly in the group above 700. Some full-time specialized poultry farms have as few as 500 hens, but a family-size specialized poultry farm usually carries from 700 to 1,200 hens. Class E farms are found in all the groups from 100 to 700, but part-time farms which make poultry production their main effort usually have from 150 to 300 hens. Class F production is not reported in the census.

TABLE 96. SIZE OF POULTRY FLOCKS IN THE UNITED STATES IN 1930 AND 1940

No. of chickens	*1930*	*1940*
Under 50	2,948,000	3,016,100
50 to 99	1,189,000	1,100,600
100 to 199	859,800	735,800
200 to 399	305,800	238,000
400 to 699	47,400	38,800
700 to 999	10,710	9,590
1,000 to 2,499	9,620	10,230
2,500 and over	1,600	1,910

Source: Number 4 months old or over on April 1, 1940, and number 3 months old or over on April 1, 1930. These data are from *Special Poultry Report*, Census of 1940.

The 1930 and 1940 census counts are not strictly comparable, but there is no mistaking the trend toward more of the specialized poultry farms and fewer of the others. The decline is mostly in the groups from 100 to 399 hens. More detailed data show that the increase first appears in the 800–899 group. The small increase in the group "under 50" reflects only a fuller counting of small farms in 1940 than in 1930.

In spite of the general distribution of farms having poultry in this country, production of eggs and poultry for sale is fairly well concentrated. The largest source is in the North Central states; nearly half of all the eggs are produced in this general region, and 40 per cent of the chickens sold. The concentration per unit of area, however, is greatest along the Atlantic Coast from Maryland northward to Maine. Other important localized production areas are found in California, Washington, and Oregon, and minor ones in central Utah, in northwestern Arkansas, and western New York and Pennsylvania. Elsewhere, the value of eggs produced is relatively small. The 2,650,000 farms reporting poultry in the South produced only a fourth of the eggs, and a smaller fraction of the sales. The concentration of farms with 400 hens or more, or raising 800 or more chickens, is much more pronounced

along the Atlantic and Pacific Coasts than in the Midwest. Between 1930 and 1940, the Atlantic Coast region gained at the expense of the Midwest, and even of most of the Pacific areas.

The large movement of eggs, other than from farm to city, is from the Midwest to the East. The Pacific Coast movement to the East has been declining. The eastern Great Plains states from Texas north also have sizable surpluses. The South ships more chickens than eggs to the Northeast. The Pacific Coast areas emphasize eggs, and some areas in some years have deficits of poultry meat. The Midwest farms run more largely to the heavy breeds — Plymouth Rocks and Rhode Island Reds — and this means a relatively high ratio of meat to eggs. Except in New England, the Atlantic Coast areas favor Leghorns for eggs, as does the Pacific Coast, but the Reds and Rocks for broilers and fryers. For the United States as a whole, only about a third of the poultry income is from meat. A survey of poultry breeds in 1930 reported 37 per cent as Leghorns and 5 per cent as other light breeds; the Rocks and Reds as 17 per cent each, and the other heavy breeds as 8 per cent.

From the first censuses of poultry in 1880 and 1890 to 1940, the number of chickens has multiplied three times and the eggs produced four times, while the population was increasing 1.3 times.[1] In the same period, the number of geese fell off 93 per cent; the number of ducks, 67 per cent, and the number of turkeys, 58 per cent. Turkeys, however, have been increasing since 1920. These changes furnish the key to the poultry history of this period. Sixty years ago, nearly all farms kept a small flock of hens and traded in a small surplus of eggs for groceries. Many of these farms also had a few turkeys, geese, and/or ducks, as an additional small source of income. The women of the family looked after all of these. Today, almost one farm in six has no poultry at all, and only a few have turkeys, geese, or ducks. The farms that really produce for the market have larger flocks; a large number of them have expanded their poultry enterprise till it contributes 10 to 20 per cent of the farm income; some have made it one of their two or three main enterprises; and a small number have gone over to poultry entirely.

The effect of these changes has been an expansion of poultry production in the Midwest along with the expansion of livestock production generally. In the Far West, and to some extent on the eastern Great Plains, wholly new production has developed. In the Northeast, many farms have shifted from other lines to poultry. Chart 129 shows how poultry production has expanded in the Middle Atlantic states while

[1] Averages of two censuses taken to correct somewhat for irregularities in enumeration.

land in farms and number of cows have declined. I. G. Davis described this shift very well in terms of Connecticut: "Poultry farming is historically one of the more recent types in Connecticut. Its existence as an important type rests on a combination of unique circumstances. On the production side, many farms in Connecticut have, as a result of technical progress in agriculture and the development and competition of the frontier in earlier generations, become unsuited to profitable livestock and general farming. At prevailing prices they are submarginal for the production of beef, wool, butter, and cheese. Nevertheless, the farmhouses are usually good. The barns and other buildings can be converted to the uses of the poultryman. The persistence of the agricultural tradition tends to continue the farms in agriculture. On the consumption and marketing side, the northeastern United States constitutes an unexcelled market for high-quality fresh eggs. To supply this market, specialized commercial egg production was undertaken in the early years of the century and has gained increasing momentum since. Both the market and the consumer definitely favor eggs from nearby. A set of marketing agencies, country buyers, peddlers, cooperative associations, and auction markets have come into existence to supply the demand for nearby eggs."[2]

POULTRY FARMS

The 1930 census classified 166,517 farms as *poultry farms*, that is, as deriving 40 per cent or more of their income from the sale of eggs, chickens, ducks, turkeys. The 1940 census classified 217,570 as poultry farms, setting the limit at 50 per cent. Farms with sizable poultry flocks and with the head of the household working off the farm 150 days or more during the year were called part-time farms in the 1930 census, and poultry farms in 1940. The gross value of product of the average 1940 poultry farm was $1,650 compared with $1,960 for dairy farms. The net incomes would have differed still more because the poultry farms buy nearly all of their feed, and feed makes up half the costs. These farms were highly specialized, deriving 72 per cent of their income from poultry and poultry products, 11 per cent from other livestock, and 7 per cent from crops of all kinds. The poultry farms of New England and the Pacific states obtained 84 per cent of their income from poultry, and those of the Midwest only 60 per cent of it. The poultry farms of Delaware produced 46 per cent of the state's agricultural output. Comparable figures for other leading states in order were New Hampshire,

[2] I. G. Davis, *Connecticut Types of Farming*, Connecticut Bull. 213, 1936.

27 per cent; Connecticut, New Jersey, and Massachusetts, each 21 per cent; Rhode Island, 17 per cent; Pennsylvania, 16 per cent; and Maryland, 15 per cent.

Further data are available only for the poultry farms of 1929. These averaged 62 acres of land, and were valued at $6,000 at the real estate values of that year. They spent $700 for feed, out of a gross income of $2,000, and $100 for labor. They had only two cows on the average.

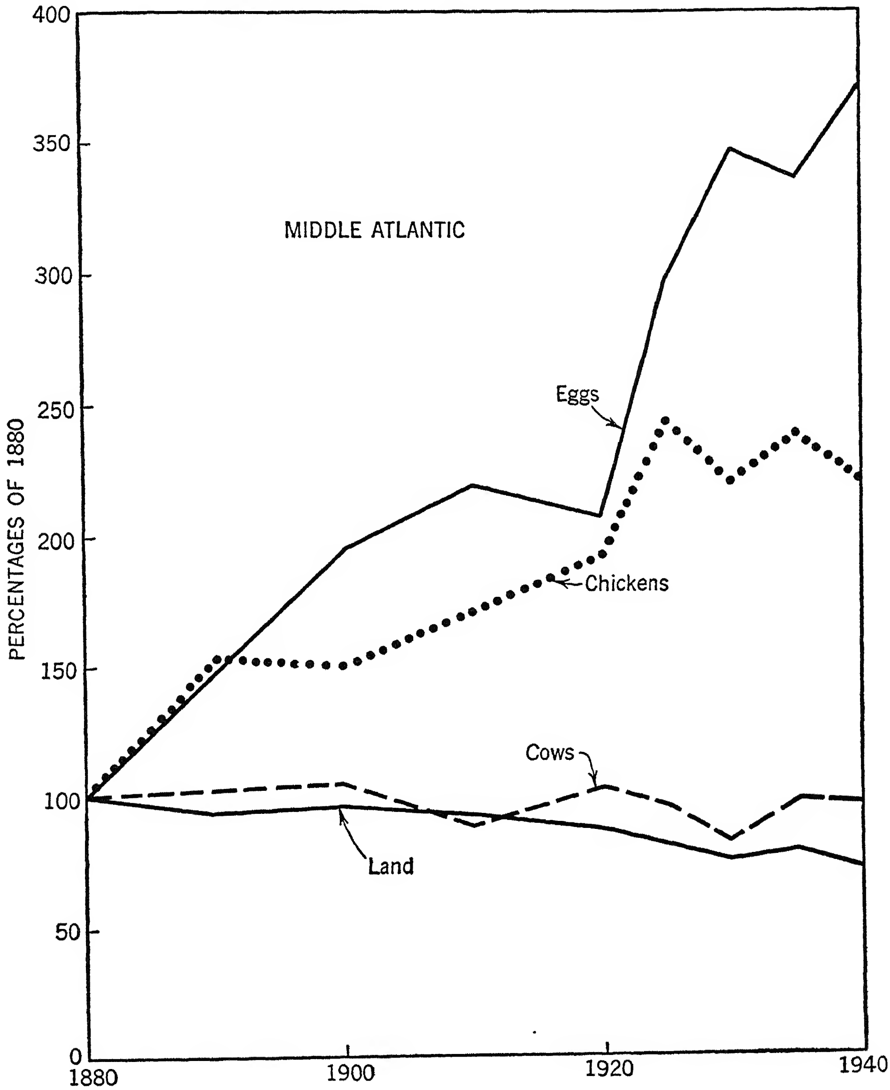

CHART 129. Changes in chickens and egg production, Middle Atlantic States, 1880–1940, compared with land in farms and number of cows.

The California farms averaged only 27 acres and $3,600 of gross income. The less specialized poultry farms of Missouri in the Midwest had 93 acres of land and kept three cows, and spent only $200 for feed — they averaged 32 acres in crops.

POULTRY FEED

A survey of farm poultry rations in February, 1944, showed that commercially mixed mash supplied a third of it; home-mixed mash, 12.4 per cent; corn, 23.8 per cent; wheat, 10.6 per cent; oats, 9.8 per cent; commercial scratch, 6.4 per cent; and barley and sorghums together, 3.6 per cent. Corn fed as scratch makes up nearly a third of the Midwest and Southern poultry rations, and wheat is used in the same way in the West. Oats make up a fifth of the ration in the West North Central states. In the Northeastern states, commercial mash averages half the ration, and commercial scratch one fifth. The Pacific states use commercial mash for half the ration, but use wheat and other grains for scratch.[3]

This survey also reported for the United States as a whole 10.0 pounds of feed per dozen eggs for the heavy breeds, and 8.3 pounds for the light breeds. The feed inputs were lowest in some of the Southern states with small flocks which forage for much of their feed. In the Pacific Coast states and some of the Northeastern states, the feed inputs are as low as 7.2 to 7.4 with the light breeds.

SEASONAL ADJUSTMENTS

One of the major management problems of poultry production for the market is that of obtaining a more regular output over the year. Chart 130 shows considerable progress in this direction since 1925. This has come because commercial producers have learned more and more about how to feed for winter production and because more of the production is specialized. It has been learned that the major factors in low winter production are the lack of sunlight and certain elements in the rations that are ordinarily obtained by foraging for green foods, worms, and insects during the spring, summer and early fall. By hatching chicks to come into production when the eggs are wanted, and by feeding layers on rations with the needed proteins, vitamins, and minerals, a poultryman can now keep his egg production almost stable over the year.

[3] *Farm Poultry Feed Ration and Feed Consumption per Layer and per Dozen as of Jan. 1, 1944, by States*, U.S.D.A., B A E, 1944.

The practical problem arising from this is the balancing of the extra costs involved in any seasonal program against the extra prices received. The costs are increased by the somewhat higher cost of the winter poultry ration and the higher costs of the replacements, which may include extra brooding equipment and housing, and reduced by the higher production per hen. Production per hen in the spring months has increased very little in the past twenty years. Most of the increase has come in the fall and winter months, and to a lesser extent, in the late summer months. Chart 131 shows the range in seasonal prices for New York Firsts for 1936 to 1938 and 1926 to 1928.

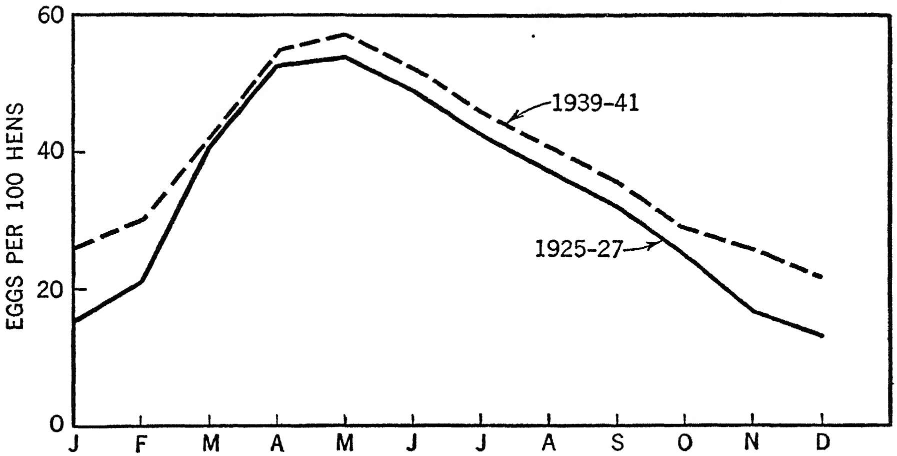

CHART 130. Egg production per 100 hens and pullets on first day of each month, 1925–1927 and 1939–1941, United States.

Many of the poultrymen in the Northeast now plan to keep their brooders in use nearly all of the time. The hatcheries are in continuous operation producing chicks either for the egg producers or for the broiler producers. When the pullets are moved to the laying pens, any late maturing pullets are culled out, and those that do not develop into good layers are culled out a few months later. Pens of older birds are combined at the time of the severe cullings around one-year-old. The poultrymen who have egg routes are particularly desirous of having even production. Some of them have small hatches every ten weeks from October to May. Almost the same distribution is obtained by starting about one fourth of the pullets in September-October, another fourth in January-February, and a half of them in March-April. The spring-hatched birds are reared a little more cheaply than the fall and winter ones. Birds hatched after late May do not grow very well. Other New England

poultrymen start pullets only twice a year, in October and in late spring. Chart 132 shows a clear difference in the distribution obtained with these two systems as practiced on two poultry farms in New Hampshire.[4] The production per hen is almost the same, and at prewar 1936–1938 prices in the New York market, shown in Chart 131, the eggs from the second flock would sell for slightly more than from the first, because eggs are higher in price in October-November than in July-August-September. But no doubt most of the producers striving for even production are supplying a special market at premium prices.

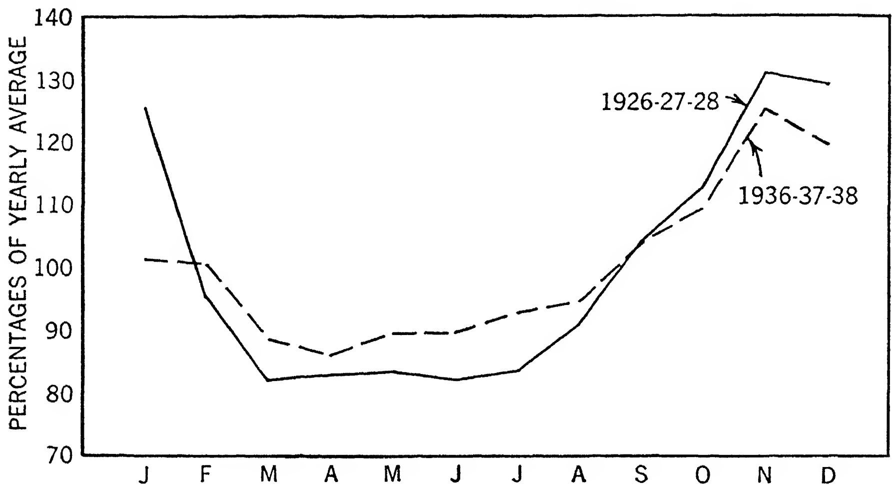

CHART 131. The seasonal variation in prices of New York Firsts grade of eggs 1926–1928 and 1936–1938.

The other two distributions are for flocks in the Midwest with hatchings in early spring — March or late February — and late spring-May.[5] At the monthly prices shown in Chart 131, the eggs from the first of these flocks would sell for about 2 cents more per dozen than from the second. The early-hatched flock averaged 6 per cent more eggs per year than the late-hatched flock. The New Hampshire flocks averaged 15 per cent more eggs than the Michigan flocks, but other factors may have entered into this.

More and more Midwest poultrymen, or farmers with flocks of a few hundred hens, are following the early-flock system. They start baby

[4] The data for these flocks was supplied by Richard Warren of the University of New Hampshire.

[5] These distributions follow closely those in Figure 17 in Michigan Special Bull. 294, *Profitable Poultry Management*, by K. T. Wright.

chicks in brooders in late February or early March, move the pullets to the laying houses early in August, cull out some of the pullets in early winter, and cull out the nonlayers from April to August, half the birds being culled out by this time. The laying flock starting each fall is thus only one third of old hens. To average 1,000 layers over the year, the number of pullets moved into the laying pens in August will need to be somewhat more than 667. If lights are used, they are turned on toward the end of September. This system requires only outdoor shelters on ranges for the rearing of the pullets.

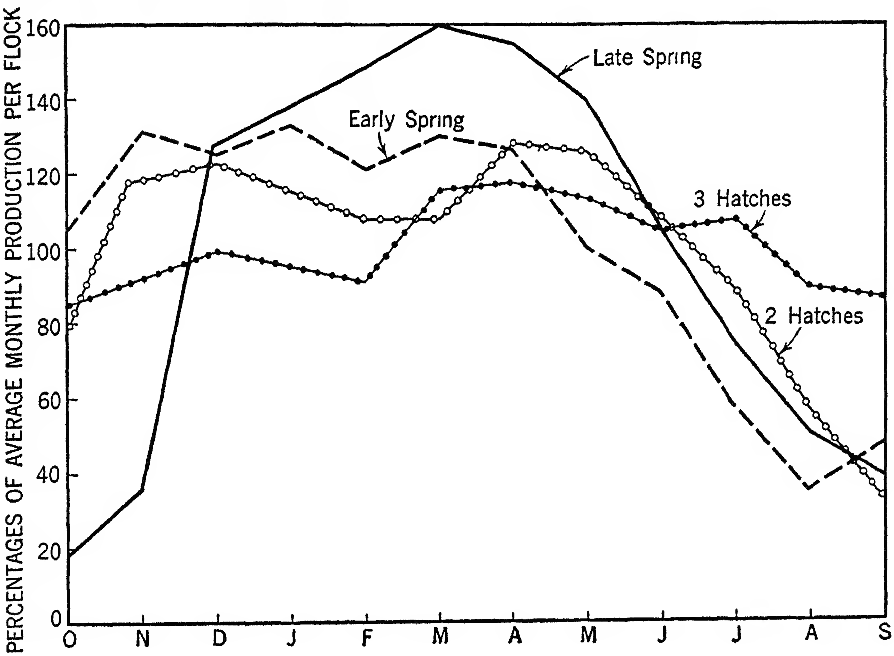

CHART 132. Seasonal distribution of egg production with four seasonal production programs.

The Committee on Animal Nutrition of the National Research Council has developed a table of Recommended Nutrient Allowances that includes all the elements necessary for winter egg laying, in terms of nine vitamins and five minerals, plus proteins.[6] These will be provided by a laying mash plus grain that is composed of 62 to 77 per cent of ground grain and grain by-products, 3 to 5 per cent of animal protein supplements (meat scraps, etc.), 15 to 19 per cent of additional protein supple-

[6] W. W. Cravens, H. J. Almquist, L. C. Norris, R. M. Bethke, H. W. Titus, *Recommended Nutrient Allowances for Poultry*, A Report of the Committee on Animal Nutrition, National Research Council, Washington, D. C., 1944.

ments of vegetable origin, 4 to 10 per cent of dehydrated alfalfa meal, 2 per cent each of bone meal and ground limestone, and a Vitamin D carrier, usually a fish oil.

If the chicks are to grow rapidly, this ration will need also to include 2 to 5 per cent of riboflavin supplements; and if the eggs are to be reasonably fertile, the hens will need 5 to 7 per cent of riboflavin supplements. These rations are now within the reach of most poultrymen and cost only a little more than the usual rations fed in the past.

These four seasonal programs also have somewhat differing by-product incomes from the sale of culls, and of broilers if unsexed chicks are used, and differing expenses for baby chicks or replacements. The turnover is most rapid with the first system, and least rapid with the fourth.

The seasonal production program that works out best in any area and on any particular farm depends upon the seasonal variation in prices in the local market — of culls and broilers or fryers as well as of eggs; upon the local prices of poultry rations; upon the available equipment, and upon the skill of the operator in feeding, disease control, culling, and buying and selling. The composite effects of these factors can be tested most realistically by fitting them together into a budget analysis of the most likely alternatives.

The flattening out of the seasonal range in egg prices after 1926–1928 had by no means reached its limit in 1936–1938. The specialized producers in the Northeast who have taken advantage of the new methods while the range is still wide have profited considerably and have expanded their output. As more poultrymen in other regions adopt the new methods, however, the range will narrow and some of the higher-cost producers in the Northeast will disappear from the market.

At the same time, the movement of eggs into storage from March to June, and out of storage from September to January, will decline. In the prewar years, the storage stocks ran as high as a tenth of the annual production at their peak. Poultry stocks at their peak were only half this high.

RATE OF FEEDING

When the available experimental data on poultry feeding are organized in the same way as the data on dairy feeding usually are — maintenance ration plus production ration, with no eggs assumed to be produced at all until the maintenance ration has been exceeded — the results obtained take the form appearing in Table 97. Above 3.0 pounds, the maintenance ration of a hen appears to increase, on the average,

If these statistical results were valid, they would show the pullets laying as many as 90 eggs with as little as 40 pounds of feed, and perhaps laying 40 eggs with no more than 30 pounds of feed. On the other hand, they would show the output from additional feed considerably less above the

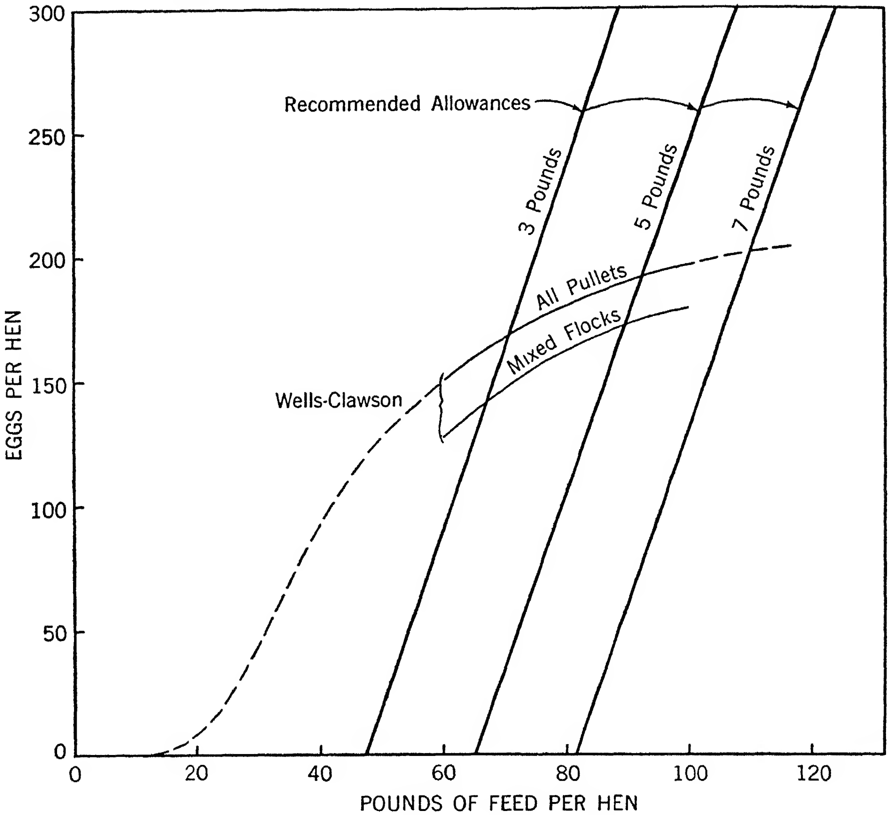

CHART 133. Input-output relations in the feeding of hens according to the Recommended Allowances of Table 97, and according to the Wells-Clawson statistical analysis.

maintenance ration and decreasing slowly thereafter. It must be remembered that these are flock and not individual hen records, and that they no doubt include some hens with maxima well above 200 eggs; but as many more with lower maxima. They may easily represent the input-output relations with whole flocks under actual farm operating conditions more nearly than the Recommended Allowances.

If the Recommended Allowances were taken as a basis for figuring, the combined maintenance and production ration for a 3.5-pound Leghorn hen capable of laying 300 eggs would be 67 pounds per 100 eggs

if she laid only 100 eggs, but only 40.5 per hundred if she laid 200 eggs, and 31.7 pounds if she laid 300 eggs. A poultryman with only 300-egg hens could thus afford to pay well for meat scraps, alfalfa meal, and fish oil, if by this means he could get them to eat more feed and lay more eggs, at the off-season when the extra eggs must be laid. In practice, against the gains from this source he would need to weigh the high costs of more vigorous culling and raising more replacements; also probably of increased mortality. The balance between these two would be reached at the point where the last input of feed, replacements and other expenses just paid for themselves. If the laying flock included mainly birds of lower capacity, he would find himself feeding more nearly the 40.5 pounds of feed per 100 eggs.

If input-output relations like the curve in Chart 133 were taken as a guide, the poultryman with a flock of pullets would find himself using something like 60 pounds of feed for 150 eggs — or 40 pounds per 100 eggs — and 100 pounds of feed for 200 eggs — 50 pounds for 100 eggs. These results would be in keeping with those obtained in the feeding of dairy cows, swine, and beef cattle presented in earlier chapters. They would indicate *additional outputs* decreasing from somewhere around 40 to 45 pounds of feed, and *average* outputs from somewhere around 65 to 70 pounds in the manner shown for dairy cows in Chart 57. The point where the last unit of feed would be paid for by additional eggs would obviously come much sooner than if the straight-line relationships in Chart 133 were taken as a basis.

With Table 97 as a guide, one can easily show the economy of using the light breeds if only eggs are wanted. A 6-pound Plymouth Rock hen, according to this table, needs 10 more pounds of feed per year than a 3.5-pound Leghorn if she is to lay 200 eggs in a year. Moreover, it will probably be harder to get the Rock hen to lay these eggs — she will be more likely to convert extra feed into gain in weight before reaching the 200-egg goal. Part of the increased feed weight, however, will be offset by increases in the size of the eggs — if the eggs are sold by size or weight. That this table may overstate the maintenance requirements, however, is suggested by the circumstance that if the average rate of 8.2 pounds per year for each pound more or less in the weight of the hen is projected backward, a hypothetical 1-pound hen would need 30 pounds of feed, and a 0-pound hen would need 22 pounds. With lower maintenance requirements, the heavier hens would appear at less disadvantage.

It is impossible, moreover, to run a poultry farm without also having poultry meat as a by-product. Even the Petaluma (California) producers

who used to destroy the male chicks had culls to sell. Rhode Island Red cull hens weigh around a half more than Leghorn hens. The Leghorn male chicks reach the broiler age almost as soon as the Reds, but the trade much prefers a Red broiler, or even more, a Rock-Red cross with yellow skin and legs. The Leghorns reach the fryer stage of 3.0 to 3.5 pounds at around 17 weeks, and the Reds, their fryer stage of 3.5 to 4.0 pounds at around 16 weeks. To grow a Leghorn male to 3.5 pounds takes 18 pounds of feed; to grow a Red to 4.0 pounds, takes only 14 pounds.

DEGREE OF SPECIALIZATION

It is apparent that a wide range of alternatives are open to the poultryman in the extent to which he specializes in one line of poultry production. At one extreme, he may buy sexed Leghorn chicks and sell them at one and one half pounds; at the other extreme, he may keep Rocks and raise his cockerels to the roaster stage. Between these extremes there are a half dozen alternatives. He may also choose between buying his chicks and keeping a breeding flock and hatching his own chicks, and to keep his incubators busy may do custom hatching part of the year. He may, for example, intentionally combine broiler and egg production as parallel enterprises.

In general, poultry farming requires such a high degree of skill and attention to detail that the usual farmer does well to simplify his operations and specialize in eggs or broilers as far as he can. Those with more ability and energy can, however, increase their income by diversifying *where other conditions favor it.* The premium for strictly fresh eggs in large Eastern markets may pay well for the cost of transporting feed from the Midwest; but the premium on local supplies of broilers and fryers may not — especially if consumers turn to using the quick-frozen product more than now. The specialized hatcheryman may be in a position to keep his equipment in fuller use than the egg producers and to sell baby chicks cheaper than a poultryman can produce them. Or it may be that other areas produce stronger chicks than the farmer can produce from his own eggs. The Delaware and New Jersey broiler producers, for example, seem to favor chicks hatched in New England.

A good deal of localization of special types of poultry farming has therefore already appeared, and more is likely to develop. Conditions in particular areas are likely to favor one type of farming and a majority of the farmers in the area practice this type. But individual farmers may deviate to their advantage from the prevailing type because of special

qualities of management or for other reasons. Or the area may be about as well suited for one type as for another. The individual farmer, therefore, may need to analyze his operations carefully from time to time to see if he is making the best of his opportunities.

BREEDING

A special reason for breeding replacements on the farm may be the same on poultry farms as on dairy farms — a desire to increase the productivity of the flock. An argument can be started among poultrymen any time merely by saying that new techniques in feeding, or in breeding, have contributed most to the rapid increase in output per hen in recent decades. Poultry lends itself readily to the application of the new principles of applied genetics that are becoming general knowledge. That wide differences exist between the egg-laying propensities of different flocks has been demonstrated in many egg-laying contests. Take, for example, those of the New Jersey Agricultural Experiment Station.[8] The contestants selected 16 pullets reared from a sample of 100 eggs chosen from their general flock matings. These were fed and handled exactly alike. The range in net returns over feed costs was from $3.37 to $5.43 per pullet in 1943–1944. Some of these hens consumed much more feed than others, and produced more eggs in consequence — they had larger *capacity*. There may also have been some differences in the *efficiency* of feed use. The condition of the pullets when entering the contest could have been only a minor factor in the results — most of the differences must have been inherited.[9]

Many poultrymen, however, will not find it feasible to breed their own replacements. In that case, they should make an effort to buy their chicks only from flocks that are being bred for productivity; and every poultry area needs poultrymen who specialize in producing hatching eggs from flocks whose breeding is carefully planned.

LABOR EFFICIENCY

Poultry farming, like dairy farming, may need to economize on the use of labor if it is to hold its own with other lines of farm production. There is already a wide range of differences in the amount of labor used in caring for 100 hens — for flocks averaging 500 hens, 200 to 410 hours

[8] C. S. Platt, *Hints to Poultrymen*, August, 1944.

[9] Some of the poultrymen may have been more successful in selecting high-laying birds. The flocks may not differ as much as the birds chosen to represent them.

per year; for flocks averaging 1,000 hens, from 190 to 330 hours. Efficiency in the use of labor is achieved in some large poultry farms in Utah by having the laying houses all built to the same pattern, so that the same labor routine fits all of them, and so that trucks can drive from one to the other and unload feed and carry away the filled crates of eggs. One man is able with such a system to care for 2,000 layers with only occasional helpers. Contrast with these laying houses the converted barns of the Northeast with laying pens on two floors. A few large laying houses with mechanical devices to assist in handling the feed and eggs, and to facilitate cleaning, are now in use in which one man does most of the regular work in caring for four or five thousand hens.

ADJUSTMENTS TO THE MARKET

Specialized poultry farms cannot very well shift to other lines of production when price-ratios are unfavorable; but they can reduce some of their expenses. Feed expenses, for example, may sometimes be cut by buying cheaper feeds, perhaps with less proteins, or less animal protein. When margins over cash costs are high, the poultryman does well to keep as many layers as his facilities will handle; and to reduce his flock when margins are narrow. Consider two possible programs for two years in which the margins per hen are $2.00 and 50 cents respectively: the first program to keep 900 hens each year; the second to keep 1,200 hens the first year and 600 the second. The first program will net the farmer $2,250 in the two years, and the second $2,700.

Chart 134 shows the movement of egg-feed ratios by months from 1925 to 1943 above and below the 1931–1940 average. The ratios are expressed in terms of the number of pounds of poultry feed equal in value to one dozen eggs in the local markets. The 1931–1940 average was 18.4 pounds. The average 4.5-pound hen in the United States laid 84 eggs in 1939. She needed 72 pounds of feed according to Table 97. This is 10.3 pounds of feed per dozen. (The difference between 10.3 and 18.4 mainly covers the costs other than feed.) The usual range in yearly average egg-feed ratios is from 14 to 21 pounds, but in individual months the ratios may run much higher or lower. Unfortunately, the fluctuations have no regular pattern. The most that can be said is that when they are high or low they tend to stay that way from one to two years.

The Bureau of Agricultural Economics also now releases currently a ratio which is in terms of pounds of feed equal in value to one pound of chicken, live weight, the 1934–1943 average being 8.3 pounds; and a parallel turkey-feed ratio with 9.2 pounds as the average.

COMBINATION POULTRY FARMING

Most of the dairy-poultry, vegetable-poultry, and other combination types of farming came into existence as a result of trying to expand a farm business on a small acreage of land, as in the case of one of the farms replanned for Heard County, Georgia.[10] The Northeast has many farms with not enough tillable land to provide forage and pasture for an economic dairy-farm unit. Usually it pays better to buy more grain

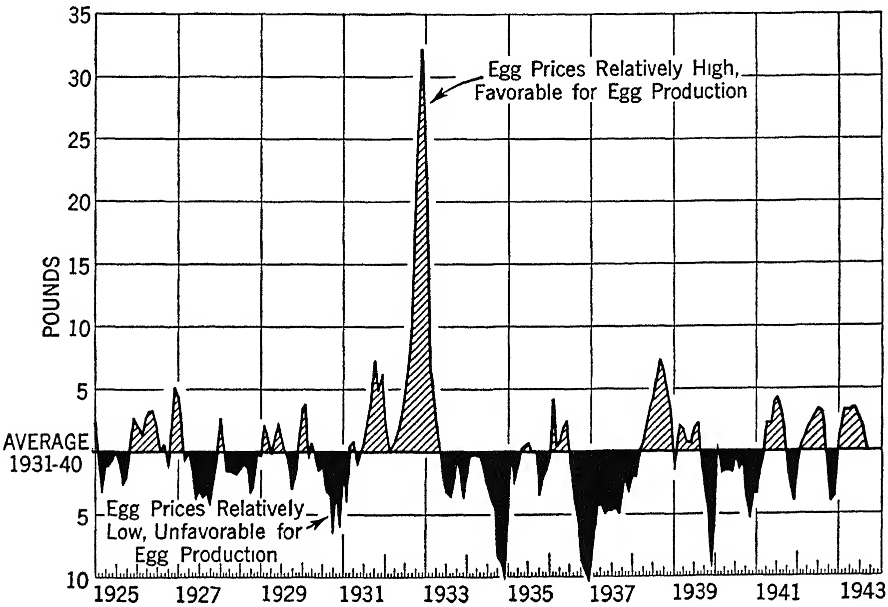

CHART 134. The egg-feed ratio, United States, 1925–1943, deviations from 10-year average. (*Outlook Charts*, 1944, p. 82.)

and enlarge the poultry enterprise than to buy hay for more cows. In other situations, the farmer may have enough of a dairy enterprise to yield an ordinary farm income but he has additional capacity and can enlarge his business more easily in poultry production than in any other way. Dairying and poultry supplement each other well in the use of labor, land, and management. In many situations, the marketing of the two products can also be handled together. Also, when the egg-feed ratio becomes unfavorable, the poultry enterprise can be reduced to nothing much more than a breeding flock for a year or two.

[10] See p. 641.

If a farmer has five or ten acres of land suitable for growing vegetables or small fruit, and not enough pasture land for a paying dairy enterprise, the vegetable-poultry combination works out well in areas near to markets. Poultry manure can be used safely and effectively in vegetable growing, and much of the refuse from the truck crops can be fed to the poultry as green feed. Usually the truck-crop and poultry programs can be dovetailed so as to provide a fairly even work load.

Poultry production can be fitted in very well in many of the Southern farms needing to shift to diversified farming. Poultry can be fitted in with cotton or tobacco as the main livestock enterprise, or it can be combined with dairying or truck crops. Dairy cows alone do not provide enough employment to make up for the loss of cotton acreage on most of the smaller farms, and hogs provide even less employment. A given amount of feed will employ more labor if fed to poultry than if fed to any other livestock. The corn and winter oats grown on Southern farms, in spite of the low yields commonly obtained, can provide two thirds of the poultry ration. A flock as small as 100 to 200 hens may produce an income from the sale of eggs and chickens, after paying for the purchased feed, more than half as large as formerly obtained from the cotton or tobacco. The poultry needs most attention at times of the year when there is little work on the cotton or tobacco.

A small cotton-dairy farm in Marshall County, Alabama, may be taken as an example of such a farm in the South. Its 100 hens produced 905 dozens of eggs in 1943 — 110 eggs per hen. Also 500 baby chicks were purchased and 300 fryers were sold. The farm has 33 acres of cropland. The dairy enterprise on this farm has been expanded until it returns more income than the cotton. Soybeans, lespedeza, and sorghum grain are grown for roughage. Corn is the only home-grown grain fed. The poultry income after the poultry feed and baby chicks were paid for was over $400.

POULTRY AS A SIDELINE

Farms with 25 to 30 chickens usually have some sales, and those with 50 to 99 chickens in the South may get from a tenth to a fifth of the farm income from poultry. An ordinary Midwest farm, on the other hand, may need 200 to 300 hens to contribute a fifth of the farm income. Probably half the farms of the United States carry poultry as a commercial sideline — they produce eggs and chickens for the market, but on a small scale. The poultry is still the women's enterprise on most of these farms, and finances many of the home improvements.

Poultry management has improved greatly on these farms in the past twenty years. The buying of baby chicks and purchase of prepared chick feeds have simplified greatly the problem of raising chickens for sale and replacements. The flocks are receiving more attention than formerly, as is evidenced by the more adequate housing, better feeding practices, and better culling. Both the layers and young chickens still generally range over the farm. Egg production on such farms in the South averages between 7 and 8 dozen per hen, and 8 to 10 dozen in parts of the Corn Belt. Poultry as a sideline is especially adapted to farms on which considerable grain is produced for feed and some labor is available every day. Only a small amount of capital is necessary to start such an enterprise. The turnover is rapid. Young chickens weighing $3\frac{1}{2}$ to 4 pounds can be grown under farm conditions in about 4 to 5 months. Young pullets raised under farm conditions will in many instances start laying in $5\frac{1}{2}$ to 6 months.

DISEASE CONTROL AND MORTALITY

Poultry pathologists have no more solved the problem of premature death from organic failure or disease than has the medical profession solved it for the human race. But they have developed programs of sanitation and disease control which, if followed vigorously, will reduce chick and layer mortality to manageable proportions. Production in small farm flocks had the advantage fifty years ago because the hens had more open range. Today it is beginning to be possible to keep disease out of poultry houses holding several thousand birds. Progress along this line has contributed largely to the increase in specialized production. The technical procedures by which such control is achieved are outside the scope of this book. But how well the poultry manager learns these procedures and how energetic he is using them determines his success in large measure. Larger flocks frequently have higher mortality than small ones because the managers are too busy to be vigilant enough.

AREA ANALYSIS

The foregoing statement of the problems of poultry management will become more meaningful if we now consider a few type situations.

WASHINGTON EGG FARMS A group of 85 Washington poultrymen keeping records in 1943 had flocks averaging 784 layers, but starting with 1,025, of which 57 per cent were pullets.[11] During the year, 53 per

[11] Arthur J. Cagle and Fred W. Frasier, *Poultry Record Study, 85 Washington Farms — 1943*, Washington Economic Series 172, 1944

cent of the hens were culled and sold, and 29 per cent of the pullets. The mortality of the hens averaged 17 per cent, and of the pullets, 19 per cent. The hens averaged 141 eggs and the pullets, 192. The egg-laying ratio of the hens for the fall months was 29 per cent, and of the pullets, 55 per cent. All but 18 per cent of the receipts were from eggs. The eggs sold at $.42 a dozen in 1943, and the feed cost per dozen was $.18, this leaving an income above feed cost of $4.75 per bird, and a return per hour of labor of $1.26. In the years before the war, the income over feed costs on this farm ranged from $1.32 to $2.37 per bird. The smaller flocks had as high margins as the larger ones.

Comparison of the records of the different producers shows a wide range in culling rates, from 22 to 60 per cent, with mortality running inversely from 14 to 23 per cent. Those culling the birds promptly when they began to fail reduced their mortality ratio and increased their output per layer. Other factors in success were forcing the hens to molt before the fall laying season, and disease control.

It is highly significant that over the ten years for which such records have been kept on a somewhat changing group of farms — the number of farms reporting has varied from 72 to 150 — there has been no improvement in the laying record, either annual or for the fall months. The percentage of pullets in the flock has not changed. The only changes appearing are an enlargement of the flocks by nearly a half and a definite rise in the mortality rate. Apparently the methods of production in this area have become pretty well routinized.

CORN BELT SIDELINE POULTRY FARMING In some areas in the Corn Belt, many of the farmers have enlarged their poultry enterprises to the point that it competes significantly with the other livestock enterprises. J. W. Oberholtzer of Purdue University made a study of groups of 38, 72, and 81 such farms in north central Indiana in 1938 to 1941.[12] In 1941, the flocks averaged 486 hens. The usual flocks, however, had between 200 and 400 hens. Only Leghorn flocks were included in the study. The receipts from sale of eggs in 1941 were $1,514, and from the sale of chickens, $267. No data are given as to the proportion of feed purchased, but if the home-grown feed were valued at the same rate as paid for that purchased, the feed would have cost $967, leaving an income over feed and chick costs of $700. The hens averaged 163 eggs. Those selling to hatcheries received 23.9 cents per dozen for their eggs, and the others 22.5 cents. Those with the larger flocks were able to sell their

[12] *An Economic Study of Semi-Commercial Egg Farms in North Central Indiana,* Purdue Bull. 486, 1943.

eggs for 2 cents a dozen more than the small producers. Those starting their chicks before April 1st averaged around 16 eggs more per hen over the three years than those starting them after April 1st, and their fall-months production was 27 per cent of the total for the year compared with 20 per cent for the later group. The eggs sold for about 2 cents more per dozen. According to the methods of computation used, the replacement costs were around 68 cents per pullet started before April 1st, and 58 cents if started afterwards. The measure of success in this study was labor returns per hen. These averaged around $1.40 over the three years for the early flocks, and 90 cents for the late flocks. The net cost per pullet raised was 63 cents with unsexed chicks and 72 cents with sexed chicks. Nothing whatever is said in this report about the other enterprises on these farms. The labor on the laying flock is about uniform at 17 hours per 100 hens per month. The labor on the growing flock is 12 hours per 100 hens in March and falls off shortly to 10 in April and 3 in August.

FLORIDA POULTRY FARMS In contrast with these Corn Belt farms are those of central and northeastern Florida studied by F. W. Brumley in 1926–1932. These averaged only 22 acres of land and obtained about all their incomes from poultry. In the year before the Big Depression, they had cash receipts averaging $4,550 and cash expenses averaging $3,270, leaving a net cash income of $1,280 from flocks averaging 760 birds. These were family-size farms. The hens averaged 150 eggs. About all the feed was purchased. About a third of them incubated their own chicks. Brumley concludes that a family should be able to care for a thousand hens.

DELAWARE BROILER PRODUCTION Sussex County, Delaware, produced 9 million broilers in 1935; in 1940, over 35 millions; and in 1943, 59 millions. Only ceiling prices and short supplies and high prices of feed kept it from expanding further in 1944. The 63 producers covered in a survey in 1943 produced anywhere from 1,650 to 24,000 broilers. The average weight was 3.1 pounds, at 15.3 weeks, the average feed input of 16 pounds costing 64 cents.[13] The chicks cost 12 cents, and the average mortality was 17.3 per cent. The feed was off in quality and the chicks had not been culled as well as formerly — some even had pullorum disease. Before the war, the broilers were usually sold at 13 to 14 weeks weighing 3 pounds. The net returns per 1,000 chicks bought were $81 after paying for hired labor. The smaller operators made

[13] Hugh A. Johnson, *Costs of Producing Broilers in Sussex County, Delaware — Winter of 1943–44*, Delaware Pamphlet 14, 1944.

higher net returns per 1,000 chicks than the larger ones, apparently because of better care of their birds. The usual margins are higher than $81 per 1,000.

CONNECTICUT AND RHODE ISLAND POULTRY PRODUCTION To get a full picture of the poultry production of an area, one needs to take an inventory of all the different types of farms including poultry, as I. G. Davis did for Connecticut. His survey covered 248 farms classified as dominantly poultry, and 256 in which poultry was second to some other line of activity — to dairy, 150; to fruit, 21; to outside labor, 43; to dairy and outside labor, 26; and to vegetables, 16. Of the 248 poultry farms, 151 had no other important source of income, 57 had dairy as a secondary source, 23 had vegetables, and 17 had fruit.

The 151 specialized farms themselves broke down into various subtypes, including hatching-egg farms, baby-chick and breeding stock farms and retail farms. Most of these also sold eggs at wholesale, sometimes for over half their income. Most of the farms had broilers, roasters and market fowl as by-products, although some were dispensing with all but the last of these by buying sexed baby chicks. The retail poultrymen made the sale of poultry an important adjunct of their egg selling.

Those of the 151 farms which were the regular type of poultry farms, relying upon sale of eggs at wholesale, fell mainly into three size-groups, 400–700 hens, 800–1,100 hens, and 1,500–2,100 hens. Nearly half of those in the middle group employed at least three months of hired labor. This apparently was about a "family-size" egg-producing farm in Connecticut.

As to the supplementary enterprises, half of the 151 had not even a cow and 53 kept one cow only. Only 10 grew more than an acre of corn for grain, only 23 more than an acre of vegetables for sale, and 20 more than an acre of fruit. Over half sold a small amount of fruit or vegetables. But the aggregate sales from other than the flock were less than $50 on a majority of the farms.

The 57 poultry-dairy farms surveyed by Davis averaged 4 milk cows and 4 head of young stock, 2½ acres of fruit and vegetables, plus 670 hens; the 23 poultry-vegetable farms, 6 acres of vegetables and 2 of fruit, plus 610 hens; and the 17 poultry-fruit farms, 5 acres of fruit and 2 of vegetables, plus 1,100 hens.

The commonest type of fruit-poultry farm in Connecticut had from 200 to 700 hens and 2 to 7 acres of fruit, mostly apples. The vegetable-poultry farms averaged around 12 acres of vegetables and from 200 to 500 hens.

To complete the picture of poultry production in New England, one needs to include a proper proportion of the small flocks of 100 hens or less, and even 50 and 25 or less. The best example of a full inventory of these is a survey made in 1934–1935 of three small areas in Rhode Island which reported 675 flocks of which four fifths had less than 100 hens and only 5 per cent had over 1,000.[14] Nevertheless, over half of the hens were in commercial flocks, a third in sideline flocks and a tenth in family-supply flocks. Some of these were on part-time farms and others in backyard flocks. Table 98 gives the principal data concerning these flocks.

TABLE 98. CLASSIFICATION OF 675 RHODE ISLAND POULTRY FLOCKS

	Specialized commercial	*Sideline farm flocks*	*Part-time farm flocks*	*Small farm flocks*	*Small backyard flocks*
Number of flocks	55	106	106	57	351
Hens per flock	669	133	80	18	18
Eggs sold per flock (doz.)	6,711	1,254	798	71	73
Eggs consumed in home per flock (doz.)	128	127	107	121	107
Eggs sold per hen (doz.)	10.0	9.4	10.0	4.0	4.1
Value poultry sold per flock	$982	$187	$105	$9	$12
Poultry consumed in home per flock	$44	$39	$26	$22	$21

FURTHER READING

*Frank W. Brumley, *An Economic Study of Commercial Poultry Farming in Florida,* Florida Bull. 105, 1940.

Marion Clawson, *Economic Aspects of Chicken and Egg Production in the United States,* U.S.D.A., B A E, 1934.

*Lawrence B. Darrah, *Factors That Affect Incomes on Commercial Poultry Farms, 1940–41,* Cornell Bull. 803, 1943.

*George F. Dow, *Egg Production in Maine,* Maine Bull. 412, 1942.

*J. L. Maxton, *An Economic Study of Poultry Farming in Virginia,* Virginia Bull. 300, 1936.

*C. S. Platt and L. M. Black, *The Family Poultry Flock,* New Jersey Circular 494, 1945.

*John B. Roberts, *Marketing and Pricing Eggs in Kentucky,* Kentucky Bull. 441, 1943.

*K. T. Wright, *Profitable Poultry Management,* Michigan Special Bull. 294, 1942.

[14] A. W. Manchester and H. C. Fowler, Rhode Island Bull. 262, 1937. The 1935 Federal Census reported just half the number of hens found in the survey.

CHAPTER XLIV

Cattle Ranching

THE INTENT OF THIS CHAPTER AND THE FOLLOWING CHAPTER IS TO introduce and examine, necessarily very briefly, the problems of management that are special to ranches as distinguished from farms. This chapter will consider cattle ranching, and the next following, sheep ranching.

A ranch differs from a farm in that the livestock gets most of its feed by grazing. No hard and fast line, however, can be drawn between ranching and some of the types of crop-and-livestock farming practiced on the Great Plains and elsewhere in the West; and much of the cattle raising practiced in this country includes the fattening of steers or calves on farm-grown forage and grains, and some even includes the feeding of purchased supplements.

Most of the grazing on ranches is on native plants, on plants that grow "wild" without any planting or cultivating or fertilizing, and the common assumption is that all of it is of this description. However, in some ranching areas the pastures may be seeded; for example, Dallis grass, Bermuda grass, carpet grass, and Bahia or Para grass may be used to improve Florida pastures. Sudan grass is sown to provide supplemental grazing on ranches in Texas and New Mexico; and reseeding or seeding of such grasses as crested wheat grass, brome grass, blue grama, side-oats grama, Lehman love grass, and chamiza is now recommended for the Southwestern ranges; of crested and bunch wheat grass in the northern and cooler ranges; and of a wide range of grasses and clovers on ranges in Oregon and Washington. It is true that very little ranching land now receives such treatment, but the trend is slowly in this direction.

Ranching on the Western ranges has a larger admixture of public management in it than any other form of agriculture practiced in this country. We have already noted in Chapter XXX the wide use of public grazing lands in the national forests, in grazing districts, and on the Indian reservations of the West. The public land used by ranchers is counted in the census as part of the ranches.

We learned in Chapter II that in the world at large two systems of ranching are followed, that of the nomadic tribes who move with their flocks, which is largely self-sufficing, and that of the commercial ranchers who own or otherwise control the land grazed by their herds, and who have fixed headquarters. Nomadic herding is today found chiefly in Central Asia, North Africa, and in the tundra areas of Asia and North America. The commercial grazing is of two types, that of the temperate grassland areas of the western United States, South Africa, much of Australia, and southeastern South America; and that of the savannah lands of warmer zones, which are covered with tall coarse grasses and often scattering trees and low brush, found both north and south of the equator in Africa, across east central South America, and across northern Australia. The savannahs have been much less fully and intensively utilized than have the grasslands. Some of the grasslands of the coastal areas of the Southeast are much like savannahs — hence, the name of Savannah, Georgia.

The great ranching area of the United States lies west of the 100th Meridian. "The western range," to quote from a report to Congress, "is largely open and unfenced, with control of stock by herding; when fenced, relatively large units are enclosed. It supports with few exceptions only native grasses and other forage plants, is never fertilized or cultivated, and can in the main be restored and maintained only through control of grazing. It consists almost exclusively of lands which, because of relatively meager precipitation or other adverse climatic conditions, or rough topography or the lack of water for irrigation, cannot successfully be used for any other form of agriculture." [1]

The grazing regions shown in Chart 135 are geographic areas, not type-of-farming areas. The Great Plains is a large and nearly treeless area with only moderate variations in relief and in carrying capacity. Most of it is short-grass country, with blue grama and buffalo grass as the dominant species. The Rocky Mountain region has great contrasts in elevation, grazing season, and forage, often within short distances. It varies from coniferous forest to chaparral and pinion juniper, to desert grass and bunch grass. The Northern desert-shrub with sagebrush dominant, and southern desert-shrub with creosote brush dominant, cover most of the Intermountain region. Grass, though sparse, is the major source of livestock feed. Much of the Pacific Coast region is covered with coniferous forest too dense for any grass. Its grazing is on the foothill grasslands.

[1] *The Western Range*, Senate Document 199, 74th Congress, 2nd Session.

Of course, not all of the vast territory shown in Chart 135 is range grazing land. About 130 million acres are barren deserts, rock, wasteland, or dense forest. Some of it is irrigated land (about 19 million acres

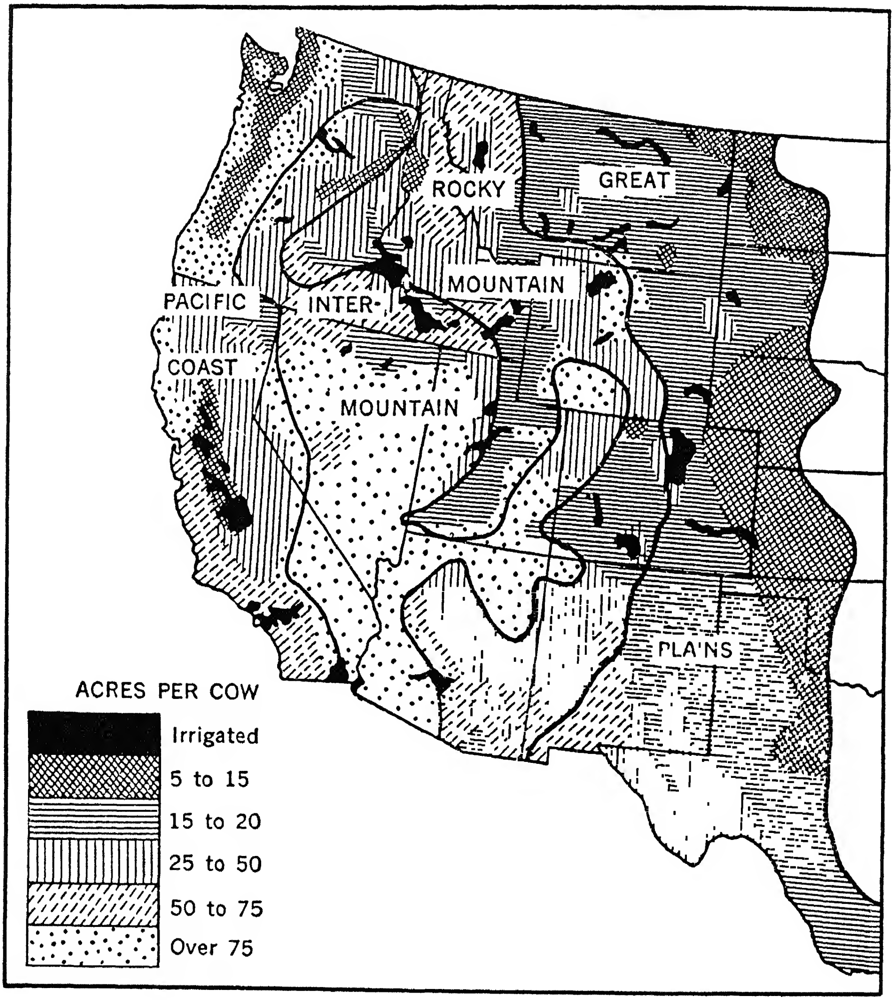

CHART 135. The four western grazing regions. (Fig. 9. Farmers' Bull. 1395, *Beef Cattle Production in the Range Area* by Virgil V. Parr.)

within the range region) or dry-farming land. The Forest Service in 1936 estimated the area of grazable range in the West at about 725 million acres. Half of this is publicly owned, nearly 90 million acres in the National Forests, 140 million acres under the control of the Grazing Service, and the rest mainly owned by states and counties.

It is customary to put the native forage plants of the ranges in three groups, grasses, shrubs, and forbs. The cattle prefer the grasses, but in the Edwards Plateau area of Texas, for example, they eat mainly curly mesquite and liveoak leaves from July through to November, largely forbs in March and April, and buffalo grass in June and July. Sheep browse on shrubs more generally than do the cattle, and use forbs better than cattle; goats consume vegetation not eaten by either sheep or cattle.

Much of the range forage is available only seasonally. This is particularly true in the mountainous areas. The high mountains may be covered with snow much of the year, so that feed is available only during a short summer growing season. The mountain regions in Chart 135 are therefore used for summer range mostly. The extensive desert areas in the Intermountain regions are used only for winter grazing of sheep because the only source of water for livestock is the winter snow. Obviously, the livestock must graze on the forage when it can be used, and at other seasons they must find their feed elsewhere. A surplus of forage at one season may be of little value at another season. A major problem in ranch organization is to match forage production at one season with forage production at other seasons.

Feed, when grazing is not available, except for fattening, is usually supplied in the form of hay. In the northern Great Plains, prairie hay is cut from the damper lowlands, and in the rest of the range country it is nearly always grown on irrigated land. It may be either native grasses or alfalfa. Roughly half of the hay in the Western states is alfalfa. This hay is usually stored in great outdoor stacks scattered throughout the hay meadows. In these dry climates, hay deteriorates but little when properly stacked. In the winter time, cattle are fed in the open, either in outdoor mangers or on the ground. In Texas, New Mexico, and Arizona, range livestock generally gets 11 months or more of feed from range land. Farther north, and in the higher mountain valleys, the winter feeding season is usually from 2 to 4 months, but may be 5 months in some years. Some high-altitude areas in Colorado and Utah have longer feeding seasons than areas in eastern Montana which are much further north. The longer the feeding season, of course, the larger the area of cropland needed.

A fairly productive range will support one animal for one month on 2 acres, or for a year on 24 acres. In the year-round grazing areas, most ranches contain from 25 to 40 acres of land per head of livestock. In the areas of seasonal grazing and winter feeding, the range lands are ordinarily less productive, but the croplands are several times as productive, so that on balance the two types of land average equally productive.

TENURE

With such large acreages of land needed to make an economic ranching unit, access to land becomes very important. At 24 acres per animal, a 200-cattle ranch, which is about a one-man unit, requires 4,800 acres of land. This is equal to a tract of land running 3 miles in one direction, and $2\frac{1}{2}$ in the other. This means that if such ranches were laid out in squares, the farmsteads would be 5 to 6 miles apart. Many of the ranches have 10,000 to 25,000 acres.

If the homestead policy of this country has stood in the way of the organization of economic wheat-farming units, as pointed out in Chapter VIII, how much more it must have obstructed ranch organization. The enlarged homesteads of 320 acres permitted in 1909 were of scarcely any help, and of little more were the 640-acre stock-raising homesteads provided in 1916. The grants of land made to railroads and states were also commonly sold to settlers in too small units. A complicating factor was that the homesteaders expected to grow wheat on much of this land. They did get a crop in some years, and this gave them an inflated notion of the value of the land. They remembered the bumper wheat crop obtained in some one year, and valued their land on the assumption that this was normal. An older settler in the northern Great Plains is reputed to have remarked: "Bumper wheat crops were obtained in this area in two years — 1916 and next year." Rents and taxes often continued to be based on the assumption that the land would grow wheat. This was done in greater or lesser degree even when the wheat region became more clearly defined and ranching came to be accepted as the permanent system of farming in the other areas. Numerous small ownerships had to be consolidated into larger units, and the owners, often absentee, wanted too much for their land. Much of the absentee-owned land, in consequence, is very loosely controlled, often rented by no one, but used by one or several ranchers without consent of the landowner.

In the mountain region, where much less land was homesteaded, the wheat-growing illusion did not develop. Lands capable of growing feed — usually mountain-valley lands and easily irrigated — were quickly grabbed up. The more productive range lands also went into private ownership. So did lands with streams or springs where livestock could obtain water. By ownership of these key tracts, ranchers could obtain use of surrounding drier lands. Large areas of the drier lands remained in federal ownership, but were used by livestock owned by local ranchers. At first this use of the federal lands was unregulated. Each rancher sought to obtain maximum use of the accessible public lands. Conflicts over

use — the "range wars" — were common and serious overgrazing resulted. In 1891, the first National Forest was established, and by 1905, a large area had been brought within National Forests. It was on these that methods of control of public-land grazing were developed. The Taylor Grazing Act, passed in 1934, brought most of the remaining federal grazing lands under positive management. In 1938, the Taylor Act lands were grazing 1,600,000 cattle, 9,200,000 sheep, 109,000 horses, and 96,000 goats. The rancher makes application for the use of these lands, and is granted a permit which stipulates the conditions under which they may be used. Adapting his ranching program to these conditions is one of the major problems which the rancher in these areas must face. These controls have brought orderliness into the use of the federal lands, but the ranchers still have to struggle with a private land tenure system that is not well adapted to ranching.

RANCH ORGANIZATION

Cattle ranches vary greatly in their organization between range areas and between individual ranches in the same area. The first problem in ranch management is therefore to choose the type of ranch organization. To anticipate Chapter XLV a little, the sheep ranches in any area tend to be far more standardized as to size and organization than do the cattle ranches. This is because sheep are herded but cattle are not. Range sheep are operated in "bands," usually of from 900 to 1,200 mature sheep, and perhaps an equal number of lambs during the summer season. Experience has demonstrated that a herder cannot properly care for larger bands, and if the band is smaller, the labor cost per head is larger. The operating unit with cattle can be more flexible as to size, and can be combined more easily with other enterprises. Cattle ranches in most areas vary from those with less than 50 cattle to those with 1,000 or more. Operating methods vary greatly also. Cattle ranches may also have one of several minor enterprises, such as dry-land wheat, some dairying, or even hog production.

TYPES OF ORGANIZATION The cattle ranches which sell nothing but cattle vary greatly in their organization. The major types of organization are the following:

A. Those which buy young beef animals, graze them for a season, and sell them in market condition. These are commonly called the *steer ranches*, although some heifers may be included in the herds.

B. Those which keep breeding animals and sell young animals, usually referred to as calves, to the A type of ranchers and to feeders. These are the *cow-and-calf ranches.*

C. Those which raise the calves at least to one year of age and usually to older ages, and sell them as "grass-fat" animals, or to feeders for further finishing. Such ranchers have all-age herds.

The Great Plains were grazed wholly on a combination of A and B type ranches during the last thirty years of the nineteenth century. Calves born in southern Texas were raised there for one, two, or even three years, and then driven north in great droves, grazing on the public lands en route. Many were sold when they reached the railroad, but others were grazed for a season or two on the wonderful virgin range of the northern Great Plains. These mature animals were able to survive most winters without hay or other feed, but in an occasional severe winter, such as 1885–1886, the losses were large.

The homesteading of the country and the development of farming gradually brought this type of ranching to an end, except in some parts of the southern Great Plains, and as far north as the Bluestem or Flint Hills section of Kansas; and except in the foothill range areas of California, where winter rains bring winter growth of plants, and range forage reaches its peak in late spring. Ranchers in these foothills buy cattle in the fall, often from ranchers in nearby states where winter feeding is required. The number of cattle purchased depends upon prospects for feed. Also, scattered all over the range territory are occasional A-type ranches where natural conditions cause low calf crops, which makes them depend on other ranches for their feeders.

The B type of ranching is found particularly in parts of the Southwest and southern Great Plains where plant growth is sparse and the warm climate is not conducive to the fattening of the animals. Most of the herds on such ranches are mature cows, and the animals sold are usually weaned calves from 8 to 12 months of age.

More ranches are of the C type than of the other two. Mature cows make up nearly half of the average herd on such ranches. These cows may be all bred in the summer so as to calve in the spring, or simply not be bred in the spring months so that there will be no calves born during the winter. In other areas, cows and bulls run together throughout the year and calves are born at all seasons. The young calf runs with its mother for approximately 8 months, perhaps receiving special care in severe weather. The fall is the usual time to sell, because the animals are likely to be in their best condition then and the cattle feeders want to buy at this time. If the calves are born in the spring, the animals sold

in the fall will be either "long yearlings" (16 to 20 months of age), or "long two-year-olds" (28 to 32 months of age). If the calves are born throughout the year, the animals sold in the fall may include a wide variety of ages — "short yearlings" of 10 to 14 months, "long yearlings," "short two-year-olds," and "long two-year-olds."

GROWTH RATES OF RANGE CATTLE

The normal pattern of weight gains of cattle according to age described in Chapter XII when applied to range cattle may need to be modified according to the condition of the feed supply. The skeletal growth of range animals is fairly uniform throughout the year, but gains in body weight are usually very rapid during the season of maximum forage production, and slow down or are even reversed in the season of minimum feed.[2] Chart 136 shows the characteristic growth behavior. Calves weigh about 70 pounds at birth. Spring calves in the Great Plains weigh about 400 pounds by fall. Since they eat little grass, their rate of gain depends primarily upon the milk production of their mothers, and this in turn depends upon available forage and the age of the cow. The heaviest weanling calves come from cows 4 to 8 years of age. During the first winter, the calves grow a larger frame, but add little or no weight. When spring comes and green feed is plentiful, they gain very rapidly again — $1\frac{1}{2}$ to 2 pounds per day from mid-April to mid-July in the southern Plains. Growth tapers off in the fall, and during the second winter the frames again enlarge with little or no gain in weight. The following spring, when the animals are two years old, another period of rapid growth ensues, with daily gains of $1\frac{1}{2}$ to 2 pounds again. In feeding trials in the northern Great Plains, two-year-old steers gained 3 pounds per day during June.[3] By the third fall, when they were $2\frac{1}{2}$ years of age, the animals weighed from 800 to 1,000 pounds, depending upon the forage available, and their sex and breeding. Thereafter, gains in weight are very gradual but may continue for several years. Large thin cattle gain weight rapidly on good range even when three years old. In Arizona and southern California, the large, thin Mexican cattle commonly bought and put on the alfalfa fields gain very rapidly.

[2] Jay L. Lush, J. M. Jones, W. H. Dameron, and O. L. Carpenter, *Normal Growth of Range Cattle*, Texas Bull. 409, 1930.

Bradford Knapp, Jr., A. L. Baker, J. R. Quesenberry, and R. T. Clark, *Growth and Production Factors in Range Cattle*, Montana Bull. 400, 1942.

[3] J. T. Sarvis, *Grazing Investigations on the Northern Great Plains*, North Dakota Bull. 308, 1941.

RATE OF STOCKING

A controversy has raged for many years between the range management specialists who insist that the ranges are generally and severely overgrazed, and the stockmen who contend that overgrazing is limited to bad tenure situations and to drouth periods, and that on the whole the ranges are properly used. This controversy reached a climax with the publication of *The Western Range* [4] by the Forest Service in 1936. The stockmen replied with *If and When It Rains.*[5] Certainly the wet years

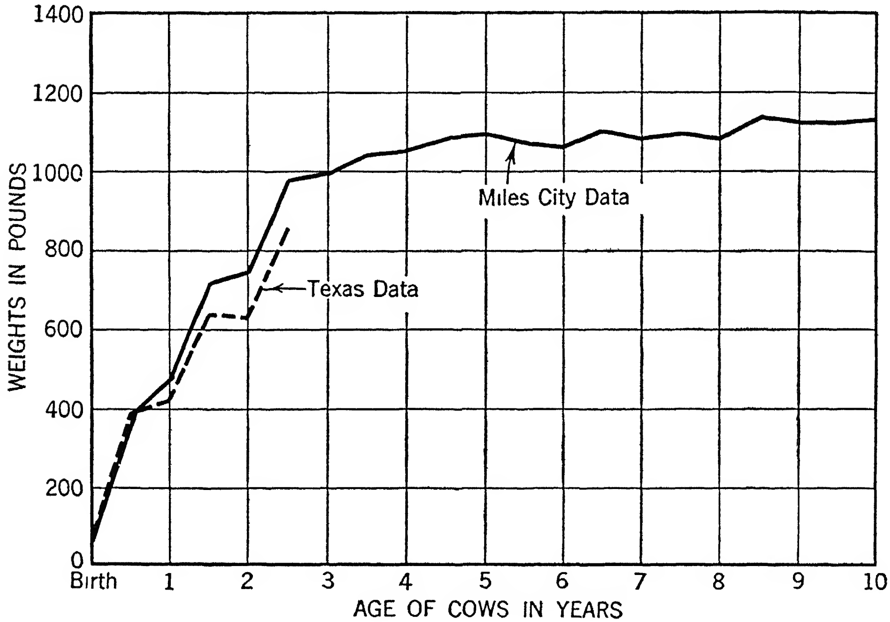

CHART 136. Average weights of Hereford range cows at various ages. (This is Figure 1 of the Montana bulletin cited.)

since 1940 have shown that many of the dire statements made about range deterioration during the drouths of the 1930's were extreme.

The problem of rate of stocking the range is a typical input-output problem, except that the output very patently cannot be measured a single year at a time, since a range can be grazed so heavily that the better species of grass are killed off and the range deteriorates. Determination of longer-run effects is complicated by the extreme variations in

[4] Senate Document 199, 74th Congress, 2nd Session.

[5] Privately printed. F. H. Mollin, Sec., *If and When It Rains, The Stockman's View of the Range Question*, American National Livestock Association, Denver, Colorado.

rainfall. Range condition depends upon rainfall in the current and preceding year.[6] Some margin of safety against drouth is desirable; in a series of dry years, such as 1931–1938 in most northern Great Plains areas, the usual margins may prove inadequate. If a series of wet years occurs, much feed will go ungrazed if the rate of stocking for average years is maintained. Proper adjustment to climatic variations, unpredictable as yet, is a major unsolved problem in Western range areas. Also, in practice it is hard to secure uniform use of the forage over an entire range. The areas near water holes, for example, are overgrazed and the distant areas undergrazed.

The optimum intensity of use varies with the forage species, with the season of use, and perhaps with the class of livestock. A common rule of thumb is that 25 per cent of the annual growth should be left ungrazed if plant vigor is to be maintained. Not only must the vigor of the perennial plants be maintained, but they and the annual plants must be allowed to mature seed.

If the range is grazed too heavily, the range is taken over by less desirable species and erosion may be accelerated. Depreciation of range lands may be at any rate the operator chooses, but the maximum rate of appreciation is set by the climatic and other forces and is very slow indeed for much range land. For instance, overgrazing has enabled cheat grass (Bromus tectorum), an introduced species, to crowd out the more desirable perennial grasses on millions of acres in the Intermountain area. Perhaps 100 years of the most careful range management would be required to reestablish the perennials, and perhaps it could not be done at all. In much of the range region, prior to coming of the white man, a rather delicate balance existed between the factors facilitating plant growth and maintenance of soil and those leading to forage and soil deterioration. This balance has been disturbed by commercial grazing in ways that the ranch operators have not realized. It is doubtful if the processes by which the deterioration has been accomplished can be reversed enough to restore much of the ranching area to its original state, at least at any cost proportionate to the values resulting. Reseeding may be necessary in some such situations, and deferred grazing generally.

A shortage of feed because of overstocking a range affects livestock weights and reproduction. Saunderson has concluded that the rate of grazing which will return maximum income from livestock production in the Great Plains in most years is a rate which will maintain forage cover, but he thinks this might not be true in the mountainous areas

[6] Marion Clawson, "Range and Livestock Condition in Relation to Annual Precipitation," *American Cattle Producer*, 1944.

where a larger proportion of the available forage is from shrubs.[7] The effects upon livestock gains depend upon the type of ranch. Thus, in experiments on steer ranches in North Dakota with 2-year-old steers purchased each spring and sold each fall, the gain in weight per acre increased slowly but steadily with the number of steers from 10 to over 30 per 100 acres.[8] The gain in weight per animal decreased, of course, with more steers, and the animals were in poorer market condition. When a breeding herd is maintained, on a type B or C ranch, the relationships are not so simple or quickly apparent. Neale has shown that weight of cows at maturity, percentage calf crop, and weight of calves at 8 months, all decline as the number of animals on the range increases beyond an optimum point.[9] These effects, however, may be obscured by other events for several years.

Most range areas went through a period of unregulated use because of their tenure history. When a range is in public ownership, open to use by the first comer, or is expected to be plowed up for farming soon, no one has any incentive to use it carefully. The feed is likely all to be grazed off, and too early in the year. Most publicly owned range land went through such a period before positive management was instituted. Much range land now privately owned had a similar experience.

RANGE IMPROVEMENT

Although ranching is based for the most part on native vegetation, this does not mean that the ranges cannot be improved; or more important, that the ravages of man from having overgrazed the land with his livestock may not in some measure be repaired. Ranges can be improved by provision of stock-watering places, by water conservation practices, by fencing, by restoration of depleted vegetation either by grazing control or by reseeding, and by removal of undesirable vegetation in some instances. The most obvious of these improvements is to supply them with stock water. Although cattle will travel distances up to 5 or even 10 miles for water, for best results they should not be made to travel more than a half mile in steep and rough country, and $2\frac{1}{2}$ miles in flat country.[10] Forage beyond the maximum distance is wholly unuti-

[7] Saunderson, M. H., *Economic Aspects of Western Grazing Land Conservation*, Proceedings of the Montana Academy of Sciences, II, 1941.

[8] Sarvis, J. T., *Op. cit.*, 1941.

[9] Neale, P. E., *Benefits, based on nutritional requirements, from proper stocking ranges*, New Mexico Press Bull. 825, 1937.

[10] Laurence A. Stoddart and Arthur D. Smith, *Range Management*, McGraw-Hill, p. 319, 1943.

lized, and that in a broad zone closer to water is used only after that near the water holes is overgrazed. Sheep, however, may do without water for weeks at a time if the forage is sufficiently succulent, and they regularly eat snow for water on winter desert ranges.

If water supplies can be provided, whole new areas may therefore be opened to grazing and the efficiency of use of much present grazing land may be improved. The chief types of water development are wells, reservoirs, and springs or seeps. Wells operated by windmills are very common on the central and southern Great Plains. The well water is pumped into large tanks from which it is fed out slowly to drinking troughs. Small reservoirs can be constructed on many small drainage basins. These should be large enough to catch a season's supply of water and yet small enough so that the flood flows can be stored or discharged without destroying the reservoir. Many small springs and seeps provide a very small flow of water which can be caught in troughs, but is wasted if allowed to form a muddy spot on the range.

The conservation of water by contour furrows or simple water spreading structures discussed in Chapter XXVII has been effective in promoting plant growth in nearly level range areas. Contouring has been particularly useful in some reseeding work; the added moisture enables the new plantings to get established.

Fencing is both a means of controlling livestock movements and of controlling grazing. Much of the western range is unfenced; in Nevada, probably 90 per cent of the range area has almost no fences. Much of the range in the Great Plains is fenced, but often in very large fields. On the Edwards Plateau, however, the ranges are enclosed with wolf-proof fences. As a result, not even the sheep are herded. To build fences means to combine more capital with a given area of land; also to substitute capital for labor. The possible gains from range fencing depend on the degree to which it aids in better range management and upon the cost of the fence.

Ordinarily the most economical method of restoring forage on ranges when some seed stock of the desired species remains, is deferred grazing, commonly taking the form of keeping the cattle off one part of the range each year. This means fewer cattle and reduced income in the present for the sake of larger incomes later.

When seed stock of the desirable species is absent, artificial reseeding is necessary. A score or more of species have been tried in most areas since 1930 and a few dependable practices and species developed for favorable locations in most areas. For the northern plains, crested wheat grass has been outstandingly successful. It has produced good forage

at relatively low cost and the new seedings have survived. Various other species can be successfully seeded in selected sites. The cost is often greater than the value of the forage obtained. Many of the species do not produce large yields of seed. The seed may be broadcast by hand or by airplane, with no ground preparation; or it may be drilled into previously cultivated fields; or it may be planted in specially plowed furrows on or near the contour. The possibilities of range reseeding, particularly on an economical basis, are by no means fully known.

The use of fire to eradicate undesirable species has considerable possibilities. Some logged-off timberland can be burned and seeded by airplane.[11] Brush ranges in California may sometimes be burned and successfully converted to grass if the brush is of non-sprouting species and if the soils are relatively productive.[12] Sites which are naturally near the border line of grass offer the greatest likelihood of success. When the brush sprouts come up, they are sometimes grazed down until killed by goats; the range is then protected until the grass becomes established. Recently, some very promising experiments have been conducted in burning sagebrush ranges.[13] How widely applicable this method may be, remains to be seen. Probably only a fraction of the vast sagebrush region is suited to this type of treatment. Fire is a valuable tool, but it is often abused and applied to the wrong sites. Brush burning on poor sites produces no permanent advantage, and may lead to severe erosion before the brush becomes reestablished.

CHOICE OF RANCHING SYSTEM

The major organization factor facing many ranchers is the system of ranching to follow. Climate and available grazing by no means determine wholly which system is best to follow. Many areas have a considerable range of choice, if not between the A, B, and C types above described, then between variants within these types. These may be found within a distance of fifty miles. Thus a survey made in 1940 of 157 ranches and farms in two adjoining counties in the Bluestem area of east central Kansas — Chase and Lyon Counties — showed the following systems of producing beef, ranked according to importance: straight grazing; wintering and grazing; cow-and-calf herds; deferred feeding; wintering;

[11] Harold R. Hochmuth and W. W. Gorton, *Ranch Organization and Range Land-use in Coos and Curry Counties, Oregon*, Oregon Bull. 381.

[12] Arthur W. Sampson, *Plant Succession on Burned Chaparral Lands in Northern California*, California Bull. 685, 1944.

[13] *Sagebrush to Grass*, U.S.D.A., A I S 27, 1945.

wintering, grazing, and feeding on grass; and full feeding. There is a wide difference in the amount of land in range and in crops even within these two counties.[14] The first system, straight grazing, is followed in parts of the Bluestem area which are suited only for grazing, and is discussed in detail later. Under the wintering-and-grazing system, the feeder or stocker cattle are purchased between September 1st and January 1st, wintered until May 1st, and grazed until September or October. This system is desirable for the farmer with grass and also roughage but without grain. It works well provided the cattle are sold each fall and stockers are purchased immediately. It gets the rancher in trouble if he tries to gamble on price fluctuations.

Cow herds in this area have been increasing in number and in size during recent years. Many farmers have discovered the stability that this system offers. More than half the ranchers following this system sell their calves at weaning time. Some grain-feed them for a short period before marketing. Others combine the raising of the calves with the three following systems, deferred feeding, wintering and selling off grass, and wintering.

The deferred feeding system is adapted to the farm that has pasture, and also produces both grain and roughage. It has proved highly satisfactory for a good manager familiar with beef-cattle production. Stocker cattle usually are purchased in October or November, wintered until May 1st, grazed until early August, full fed for 90 to 100 days, and marketed in November. This program provides efficient utilization of pasture, grain, and roughage, and enables the farmer to purchase stockers during October and November when they are at a seasonally low price and to sell fat cattle in November when good grades of fat cattle are at a seasonally high price. This system requires that only good- or choice-quality calves be used, as the common grades of fat or slaughter cattle usually reach a seasonally high price at a different time.

Although the areas surveyed in these two counties have a large percentage of their land in grass, a few have practically all of their land in crops. These are not ranches, but farms of the type discussed in Chapter XII as feed-and-livestock farms. These operators frequently winter cattle as a way of utilizing the low-grade roughages produced on their farms and adding diversity to their farm business. The stockers can be purchased in October and November at a seasonally low price and sold in the spring months at a seasonally high price. Also should be classified

[14] Adapted from *Methods and Practices Used in Producing Beef Cattle in Chase and Lyon Counties* by H. T. Doll, H. J. Meenan, J. A. Hodges, and W. H. Pine. Agricultural Economic Report No. 10 (Mimeographed), Kansas, 1941.

as farms the units which follow the system of wintering and grazing the cattle and then feeding them while on grass, and the full feeding followed on a few farms having large quantities of feed grains. The first of these was common earlier, but has given place largely to deferred feeding, which has proved to be more efficient.

In choosing between possible alternative systems in such areas, the rancher must weigh the advantages and disadvantages of each in his particular situation. Thus, a ranch that is selling two- or three-year-old steers or heifers usually can shift to a yearling basis so far as feed supplies are concerned. But the lower the age at which the animals are sold, the larger the proportion of feed that goes into maintaining the breeding herd. On the other hand, a given amount of food produces more gain in weight with younger animals than with older animals. These advantages need to be weighed against each other. It is possible to take the records for any ranch which has been selling on different bases, and the prevailing set of prices for yearlings, one-year-olds, and two-year-olds, and estimate which system would have paid best, and also to project this into the future in terms of prospective prices. This has been done by Burdick and Reinholt with six different systems for a ranch with the average amount of available feed located in the North Park ranching area in the Rocky Mountains in north central Colorado and adjoining Wyoming.[15] This ranch, operated on the basis of selling the calves, except the replacement heifers, would have 350 cows at weaning time, 100 heifers coming along for replacements, 16 bulls, and 272 calves, assuming the usual calf crop in the area. Assuming the usual death losses, there would be 220 calves left for sale. There would be 41 cows to be culled out each year. The net receipts of this ranch would be $9,750.

This same ranch operated on the basis of selling yearling steers and excess yearling heifers would have only 259 cows, 137 heifers, 12 bulls, 101 yearling steers, and 201 calves. The 31 cows and 155 yearlings sold each year would bring net receipts of $9,370.

Let these same steers and heifers become two-year-olds before they were sold and the net receipts would be reduced to $9,070. The number of cows would be reduced to 191, the number of calves increased to 148; and 110 two-year-olds would be sold.

The other three combinations involve keeping all except the replacement heifers until they are cows before they are fattened and sold. If at the same time all the steer calves were sold at weaning time, 236 cows could be kept in the breeding herd. At the prices then prevailing, this

[15] R. T. Burdick and Martin Reinholt, *North Park Cattle Production*, Colorado Bull. 435, 1937.

system would have yielded a net income of $10,840, the highest net income of any six combinations. If the steers were sold as yearlings, the breeding herd could have only 198 cows and the net income would be $10,600. If the steers were sold as two-year-olds, the breeding herd could have only 161 cows and the net income would be $10,740. Thus, it would pay to have the feed go into fattening cows rather than into keeping more breeders, even though fat cows sell for less than fat steers.

These budgets are based on the following average production rates for the area and 1929–1931 prices:

	AVERAGE SELLING WEIGHT		GAIN DURING YEAR		PRICE PER 100 LBS.	
	Steers	*Heifers*	*Steers*	*Heifers*	*Steers*	*Heifers*
Calves	385	350	385	350	$9.26	$8.25
Yearlings	685	643	300	293	7.71	6.39
Two-year-olds	1,022	846	337	203	8.15	5.73
Cows		963				3.71
Fat cows		1,085				5.71

Calf crop — 68 per cent

A major change in any of these variables might easily have affected the most profitable organization. If the calf crop averaged 85 per cent instead of 65 per cent on a particular ranch, with the same gains per animal and relative prices, the ranch income would be increased for all six systems of operation, but probably most for those selling calves rather than older animals. If the rate of gain per animal were lower, because of poorer forage or some other factor, sale of calves would prove the more profitable. In the mountain areas especially, the forage situation may vary considerably from ranch to ranch. The capable ranch manager knows the productivity and characteristics of his range for different types of production, just as the farmer knows the productivity of his land for different crops.

STRAIGHT GRAZING

Most of the rest of the problems of ranches are best discussed according to the system of ranching. Let us consider straight grazing first because it presents these problems in their simplest form. All ranches following this system are likely to have the same basic characteristic of ample grazing at one season and of a scarcity of grazing at other seasons.

Let us take as our example the typical steer ranches in the Bluestem or Flint Hills area of Kansas mentioned above. This area has mostly

native pasture of bluestem and grama grass. Much of it is rather rough and broken in topography. The pasture, if rented, is ordinarily rented by the season to Texas cattlemen, irrespective of the length of time cattle are on it. Many of the Flint Hills ranches include only 160 to 320 acres.

A major management problem on these Flint Hills steer ranches is the type of animal. Older steers make the largest gains and get into the best condition, but they involve the greatest risk of price changes. Younger cattle grow well on grass, but do not attain the same finish or degree of fatness. Thin aged animals gain most during the season, partly because they are usually held for longer periods on the pastures and partly because their gain per day is higher. Animals of this type make a gain of 2 pounds per day, or 65 to 70 pounds per acre for the season of 140 days.[16] Steers of the same age but in better condition at the beginning of the season are grazed for a shorter season, make less gain per day and per season, and require more acres per head. And much feed is left ungrazed after the animals are sold. Animals classed as fat at the beginning of the grazing season gained less than 1½ pounds per day, or only about 35 pounds per acre.

Steer ranches are particularly vulnerable to changes in cattle prices. An older steer will weigh about 800 pounds at the beginning of the grazing season; at 8 cents per pound, this represents a cost of $64. If it gains 300 pounds, but the price of cattle declines to 6 cents per pound, it will sell for only $2 more than was paid for it. The average decline is perhaps three fourths of a cent per pound. This means $16 gain per head, or $3.50 to $4.00 per acre. The risk of price changes is greater for aged than for yearling steers, because the original weight is greater in proportion to the seasonal gain. A common rental has been somewhere around $8 per head per season, although this has varied much from year to year.

This type of steer ranch, with varying arrangements between the owner of the animal and the owner of the land, persists in spite of its vulnerability to price changes. From 300,000 to 500,000 cattle are shipped into the Flint Hills each season, and from 200,000 to 300,000 into the foothills of California. Large profits are, of course, made in the occasional year when prices rise, and these appeal to the speculative spirit of many operators. Proposals to shift from this type of organization all involve having some kind of feed for the winter months — corn, sorghum, alfalfa, etc.; and often it is not easy to obtain cropland or a cheap supply of feed near-by.

[16] R. H Wilcox, W. E. Grimes, Morris Evans, and H. J Henney, *Factors in the Cost of Producing Beef in the Flint Hills Section of Kansas*, U.S D.A Bull. 1451.

COW-AND-CALF RANCHING

Most of the cow-and-calf ranches are found in one general area — the Southwest, from central Texas to western Arizona. But some are ranches scattered among the Type C ranches. The rate of turnoff on cow-and-calf ranches is relatively high, and the labor and other inputs are relatively large, even as compared with Type C ranches. The native vegetation in this area varies from typical plains grasses (grama and buffalo) and curly mesquite in western Texas and eastern New Mexico, to these same plants plus alfilaria, Indian wheat, mesquite, cat claw, palo verde, greasewood, and other shrubs in the desert and semidesert areas of southern New Mexico and Arizona. Cattle are grazed throughout the year. At the time of a survey made in 1925, this range was carrying one animal per 23 to 38 acres in various parts of this general region, and this was more livestock than the range management specialists believed was the optimum.[17] A typical ranch with 500 cows had 243 other cattle and 20,000 acres of land, and employed three men, including the operator.

This is an area of summer rainfall, with much of the precipitation in July, August, and September. There is usually enough forage to carry the cattle through the fall and early winter satisfactorily, but the picking is poor in late winter and spring before the spring or summer rains begin unless grazing is deferred on some portions of the range. Grama grass is especially fitted to deferred grazing since the mature grass maintains its palatability for livestock and apparently its nutritive value also. A common practice is to feed cottonseed cake (1 or 2 pounds daily) through the winter, particularly to thin or weak cows, or to those which calved late. Calf crops are typically low in this general area; a long-term average is probably under 65 per cent with many ranches running as low as 50 per cent or less. The 1925 survey reported a third of the ranches with less than a 40 per cent calf crop on dry years. Cows are often not in condition to breed successfully until their calf is weaned, so that calvings may be 18 months or more apart.

Cattle sales from typical ranches in this area are about one third calves, one third yearlings, and one third mature cows. There are two distinct seasons of sale: April, May, and June, when steers mostly are sold for shipment to steer ranches in Kansas and other areas; and October, November, and December, when all classes of animals are sold,

[17] V. V. Parr, G. W. Collier, and G. S. Klemmedson, *Ranch Organization and Methods of Livestock Production in the Southwest.* U.S.D.A. Tech Bull. 68, 1928.

mostly for shipment to California for seasonal grazing or for shipment to western Corn Belt feed lots. The animals sold are usually light for their ages; in the 1925 survey, when conditions were somewhat worse than usual, the calves averaged 300–350 pounds, the yearling steers 450–550 pounds, and the mature cows 750–850 pounds. The gains in weight of growing animals are even lower relatively than the calf crop. But although production per head is low in this region, costs per head are also low because winter feeding is largely unnecessary. As a result, for the same carrying capacity per acre, range land in this region supports twice as high a land charge as the land in areas where extensive winter feeding is necessary.

Ranches in this area struggle against unfavorable land tenure as in other ranching areas. Many of them are too small for economical use of the operator's labor, but the operators are unable to obtain additional land near-by at a reasonable price. The major organization objectives are to increase the calf crop and reduce the death losses. Range management experiments conducted by the Forest Service at the Jornada Experimental Range in south central New Mexico, and at the Santa Rita Experimental Range in southern Arizona, and by the New Mexico Agricultural Experiment Station at its experimental ranch in southern New Mexico, have shown that improvement is possible in both of these directions.[18] On the Arizona station the calf crop averaged 80 per cent over an 11-year period, and the death losses for the same years were only half of that reported by the Parr-Collier-Klemmedson study. Hence, meat production per breeding cow was at least a third more than on the usual ranch in the same area. Interestingly enough, however, the weights per head of animals sold were not appreciably increased. The better results on the experimental ranges were obtained largely by more conservative stocking, so that ample feed was available at all seasons and in all years. Other factors were a better type of cattle, a better water supply, and better disease control.

ALL-AGE HERDS

Under this head are thrown together all the remaining systems of cattle ranching, ranging from feeding calves over the winter and selling them as yearlings, to grazing them a second summer to be sold as long yearlings, to feeding them over a second winter and grazing them a

[18] Matt J. Culley, *An Economic Study of the Cattle Business on a Southwestern Semidesert Range,* U.S.D.A. Circular 448, 1937.

second summer, to perhaps even selling some of them as three- and four-year-olds. The composition of the herd will vary depending upon where in this range a particular herd practice falls. All of them present much more of a winter-feeding problem than the systems discussed above, and this reduces the number of breeding cows that can be maintained by a given total feed supply. Since a majority of the herds, particularly those outside of the special areas previously described, fall somewhere within this general range, it seems worth while to describe in more detail a ranch which comes within this general description.

This particular all-age cattle ranch is located in the northern Great Plains. It contains approximately 2,800 acres, of which approximately 330 acres are used for crop production. The acreage in crops varies somewhat, depending upon moisture conditions in the particular year and in preceding years. Alfalfa and wild hay are grown on the bottom lands along the small streams which cut the ranch. Corn is grown for grain and for fodder on some of the better cropland. The ranch is fenced off in large fields, or pastures, the use of which is rotated. At least one large pasture (one of the rougher ones, which provides some shelter from winter storms) is reserved for winter grazing during periods when the weather is not too severe.

The normal cattle herd consists of 165 animals, not counting unweaned calves. About 77 of these are mature cows, 3 are bulls, and 30 are yearlings and 2-year-old heifers. The usual sales practice on this ranch is to sell relatively heavy steers — 2- and 3-year-olds. Consequently, the herd contains yearling, 2-year-old, and 3-year-old steers. Normal annual sales include: mature cows, about 13; heifers, 5; 3- and 4-year-old steers, 11; 2-year-old steers, 10; and yearling steers, 3. The mature cows will average nearly 1,000 pounds when sold; the 3- and 4-year-old steers, nearly 1,100 pounds; the 2-year-old steers, about 900 pounds; and the yearling steers, about 650 pounds. The calf crop averages 67 per cent, and the death loss 2.2 per cent.

The usual sales practice on this ranch results in the sale of 42 animals a year, or almost exactly one fourth of the herd. This is a very common ratio when mature animals are sold. The annual production of beef is nearly 400 hundredweight. If this production is divided by the total number of animals in the herd, the average production per head is 240 pounds, which is considered fair under Western range conditions. The calves gained 350 pounds during their first year, but the mature cows changed weight but little.

Range forage, harvested crops, and feed requirements are in fairly good balance on this ranch. Hay yields are low, and production of ample

feed of good quality is a major problem. This is one reason for producing such heavy mature steers. These can forage better for themselves during the winter, and are more likely to survive a severe winter than cows and calves. When the calf is raised to weaning age, the tendency is to keep it in the herd as long as possible, since it is a relatively dependable meat producer.

One man did approximately half of the work on this ranch. Several men were hired for haying, and some extra help in "working" the cattle. This ranch therefore provided full utilization of the operator's time. The number of cattle that one operator can care for, with the usual seasonal help, varies from perhaps 150 to 250 in ranching areas where winter feeding is necessary. On mixed farms on the Plains combining wheat with cattle, herds of 150 may not be too small. Many of the ranches, however, are too small — heritages of the homestead program. The smallest ranches are found among the Spanish-Americans of northern New Mexico and among the Indians of that state and of Arizona. According to the 1930 census, 43 per cent of all ranches in New Mexico and 56 per cent of those in Arizona had less than $1,000 gross income.

Matching men and ranch sizes is particularly important, because of the difficulty of intensifying production with scanty rainfall. A survey of Nevada cattle ranches showed a rather clearly marked group of undersized one-man ranches with about 100 animals; an efficient group of one-man ranches with about 200 animals, whose labor inputs per animal were almost as low as on much larger ranches; an inefficient group of over one but not quite two-man ranches; another group of efficient two-man ranches, and so on.[19]

But lack of range can be partly compensated for by getting a larger calf crop and reducing death losses. The first means adequate feed, with the proper vitamin content, throughout the year; enough vigorous bulls, usually specially conditioned; disease prevention control; care of calves at and after birth, especially in severe weather; and culling of mature cows to eliminate slow or irregular breeders. Reduction of death losses involves providing enough feed not only to prevent actual starvation, but to keep up vigor and vitality, and to avoid losses from poisonous plants which are grazed heaviest when feed is short; and protection of the range from thefts of cattle.

Great flexibility in age and class of cattle sold is possible for most all-age herd ranches, and one of the major managerial tests comes in wise decisions at selling time. First is the question of which age and class of

[19] G. Alvin Carpenter, Marion Clawson, and C. E. Fleming, *Ranch Organization and Operation in Northeastern Nevada*, Nevada Bull. 156, 1941.

animals to sell, which can best be answered by setting up budgets in which the rancher makes for the alternative selling programs his best estimates of the number, weight, and price per pound of cattle available for sale from his ranch, with its particular conditions of seasonal forage, probable calf crop, probable death loss, gains per animal of each age class, and the like, with accompanying out-of-pocket expenses. There still remains the need of selecting which animals to cull and to keep, on the basis of thriftiness, vigor, and productivity. Many ranchers acquire great skill at this, and much of their financial success depends upon it. Over a period of years, the type of cattle can be improved greatly by careful culling at time of sale, coupled with equally careful choice of bulls.

THE PROBLEM OF RISK AND UNCERTAINTY IN RANCHING

Cattle ranching is exposed not only to the usual fluctuations of business and war cycles, and those of the so-called cattle cycle, pointed out in Chapter XII, but also to series of wet and dry seasons. Fluctuating prices alone would have caused the net cash income for a typical Montana cattle ranch to have doubled in World War I, fall below farm prices in general in the early 1920's, rise in 1928 and 1929 almost to wartime peaks, fall in the depression years to record lows, and then rise rapidly to record highs in World War II. There seems to be something more of a tendency for series of low or high cattle prices to occur in sequence than for prices of farm products in general. If $1,200 cash be accepted as a reasonable minimum for family living, the typical ranch above described barely made this for 5 years in the early 1920's and failed to make it in the 4 years in the Big Depression; on the other hand, high incomes were received from 1913 to 1920 inclusive, in 1927 to 1930 inclusive, and from 1939 to 1945.

With these sequences caused by prices must be combined those of wet and dry seasons noted in Chapter XXXVII on wheat farming. In Montana, the years from 1910 to 1916 and from 1939 to 1945 were uniformly above average in rainfall, and combined with the high prices to give very high incomes, and the dry years from 1930 to 1937 combined with low prices to the opposite effect. From 1917 to 1928, the climatic forces chiefly offset the price influences. Studies in Nevada, Colorado, and South Dakota show this same tendency for ranch incomes to run in series of highs and lows.[20]

[20] See Nevada Bull. 156, Colorado Bull. 435, and South Dakota Bull. 352.

The problem imposed upon ranch management by these sequences of years of high income and years of low income has two aspects: one, that of adjusting the financial program to it; and the other, that of adjusting the production and marketing program to it. A sound handling of both requires breaking the problem into two parts: one, making an accurate appraisal of the long-term average or normal income and production; and the other, adjusting the year-by-year operations to the short-run sequences. If ranchmen do not handle this problem in this way, when net income is favorable for several years, as in the 1910–1919 period, they shortly come to accept this as "normal." They begin to base their ideas of reasonable land values on these years, and to buy land accordingly. They also begin to plan their family living expenses on the basis of such returns. They forget the less favorable years in the past, or they assume that such years will not return. Other farmers make similar mistakes, but the cattle ranchers are unusually exposed to them. As a result, many of them are in serious financial straits when the sequences turn bad.

If a ranch operator has made such an analysis, he will use any income in excess of his estimate of the long-term average income to reduce his debt, make major repairs and improvements, and invest anything left over in government bonds or other highly liquid assets. His local bank was often insecure in the old days because its prosperity and liquidity depended upon the incomes of the local ranching industry. Insurance of bank deposits has improved this situation greatly.

Similarly, if a ranch operator has worked out a long-run production program, he will be less likely to overexpand not only in years of good prices, like all other farms, but also in periods of good rainfall. He will not be inclined to expand his cattle numbers so much in periods of rising prices. Chart 68 showed clearly the general tendency for cattle raisers to overreach themselves in both directions. Changes in beef-cattle numbers have generally been greater in the ranching area, especially on the Great Plains, than elsewhere in the nation. Nearly all of the decline from 1934 to 1938, and more than half of the changes in numbers at other periods, took place in the ranching territory. The speculative urge is strong among cattle ranchers, and most of the time they have gambled on good prices and good weather at least one year too long.

But as pointed out in the opening statement in this section, some adjustments are usually necessary in the short-run sequences. The problem is to differentiate between somewhat worse than usual range conditions, which probably can be weathered through without sacrifice of breeding herds, and the beginning of a severe drouth which will force

some liquidation. Dry ranges and short feed are not uncommon in the range area; they occur nearly every year in some areas, and frequently in others. In some areas, cattle normally get rather thin at some seasons — thin enough to look pretty bad to strangers. The ranchers, therefore, ordinarily hold their normal number of cattle, waiting for the better range conditions, which usually return before serious damage is done. The more serious drouths often start out the same way; by the time the rancher decides he must liquidate, his livestock may be unsalable, or even too thin to stand shipment. If a large area is in the same circumstances, it may be difficult to get shipping facilities or to find areas with surplus feed or forage for them. Large losses of cattle may be the result. This is what happened in 1934 over much of the Plains, and has happened often in smaller areas. Had a severe drouth occurred on the Plains during the recent war cattle losses would probably have been unusually large, because cattle numbers were high, extra transportation unavailable, and there was little surplus feed anywhere.

Still, this type of debacle usually casts some warning signs ahead. In the first place, a drouth does not become severe overnight; dry ranges become progressively worse over a period of time. Second, prolonged subnormal moisture, even if only 15 to 25 per cent under the long-term average, diminishes the ability of the range to produce feed even when good rains come. The density of grama grass in any year is predominantly dependent upon precipitation in the preceding year; height growth depends mostly upon precipitation in the current year.[21] If precipitation is somewhat below average one year, it must be equally above average the next year if forage production is to be normal. Third, the greatest disasters in cattle history, excepting that caused by the severe winter of 1885–1886 on the northern Plains, have all occurred when cattle numbers were unusually high. Conservatism in stocking, and ready adjustments to moderately dry periods, will save most of the heavy losses arising in this way and not reduce greatly the large gains of the years with feed enough for larger herds.

Ownership of range has important advantages in this connection. It permits working out a stable range management program and accumulating forage reserves against drouths. Leasing is cheaper over the years, however; taxes and interest on the money required to buy land exceed the usual rental cost. Rented lands may be given up if not needed, and costs reduced accordingly. If only part of the land is owned, as is usually the case, some stocks of hay can be carried from one year to another.

[21] Enoch W. Nelson, *The Influence of Precipitation and Grazing upon Black Grama Grass Range*, U.S.D.A. Tech. Bull. 409, 1934.

MAKING USE OF THE PUBLIC RANGE

Perhaps one fourth of the 71,000 ranches reported by the 1930 census use some public range. The proportion is much larger in the Mountain states, and smaller in the Plains states. The public range lands for the most part are useful only seasonally, and much of the private ranch land requires the public range to be most productive. The degree to which the private land supplements the public land is known as *commensurability;* the degree to which the private land cannot be used without public range is known as *dependency.* A mountain valley meadow would be both commensurate for and dependent on public range; irrigated land capable of raising diversified crops might be commensurate but not dependent. Some consideration has been given to priority of use in issuing grazing permits. This was especially true when the national forests and grazing districts were first created. In a given area, a rancher might have to provide 8 months' feed for his livestock in order to be commensurate for 4 months on the national forest. The Forest Service insists that grazing on national forests is a personal privilege, nontransferable except at its option, and that no equity can ever be secured in continuance of the privilege. The grazing privilege on grazing districts attaches to the base property or headquarters ranch, and is transferable with it.

The fee charged for grazing on public range lands has been the subject of much controversy and political pressure. Both the Forest Service and the Grazing Service began with low fees; national forest fees are still somewhat under a full value, and grazing district fees are still (1946) on the original nominal basis in spite of efforts to raise them. The grazing fee on the National Forest in 1945 averaged 25 cents per head per month for cattle, and $6\frac{1}{4}$ cents per head per month for sheep; it varies upward or downward in proportion to changes in livestock prices in the preceding fall, as compared with prices in a base period, and also varies according to the appraisal of each forest's productivity. The monthly fee on the grazing districts has been uniformly 5 cents for cattle and 1 cent for sheep. When private and public lands are used in one operating unit, low fees on the public lands tend to be capitalized in higher values and costs on private land.

The administration of public range lands has had both good and bad effects upon ranch organization and management. The good effects have resulted from positive management of these lands to prevent deterioration from uncontrolled use. Also, the ranchers now know how much livestock they can run for a specified season, and there is good assurance

owned by the Union Pacific. This association began operations in 1908, and has done a noteworthy job of range conservation.

The Taylor Grazing Act, as amended, provides for elected, official Advisory Boards of stockmen. These boards meet rather regularly and advise the Grazing Service on all matters of administration affecting their district. While the Grazing Service is not compelled to follow their advice, it is likely to do so because it represents the dominant opinion of ranchers in the area. While Grazing Service actions relate directly only to the federal land, indirectly they affect private land because they specify the conditions under which use of the public land may be secured. In this way, stockmen as a group exercise a collective or group control over range land use in their locality.

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CHAPTER XLV

Sheep Ranching

SHEEP RANCHING HAS MUCH IN COMMON WITH CATTLE RANCHING. IT IS based even more upon the grazing of native vegetation. It tends to be concentrated in the mountain and intermountain regions. Except on the Edwards Plateau of western Texas, less than a fourth, and in many sections less than a tenth, of the ranches on the Great Plains are sheep ranches. Although the census data do not separate cattle and sheep ranches, one can estimate from them that 50 to 60 per cent of all ranches are cattle ranches, 20 to 25 per cent are sheep ranches, and 15 to 20 per cent are cattle-and-sheep or "mixed" ranches. In the Edwards Plateau district, the ranches combine cattle, sheep, and Angora goats, and a few there and elsewhere depend mainly on goats.

Sheep are frequently converted to an animal-unit basis on the assumption that 5 sheep equal 1 mature cow. An animal unit of sheep computed on this basis produced, for all the Western states combined for the 1924–1941 period, 194 pounds of meat, in contrast with 226 pounds of meat from an animal unit of cattle. But the sheep produced, in addition, 42 pounds of wool per animal unit.

Except on a few northern ranges, sheep graze throughout the year. They do this even though cattle in the same areas are winter-fed. Range sheep are usually lambed on the open range. Later, the sheep are shorn at some central point from which the wool is shipped to market. Range sheep are always bred at one season so that all the lambs are born at approximately the same time. The lambs produced are always sold as lambs, ordinarily within a very narrow time interval. The age at which animals must be marketed is thus greatly restricted as compared with the ages at which cattle may be sold.

Range sheep are typically herded. The breeds used have the herd instinct to a marked degree. If a small number of them become separated from the main band, they strive desperately to return to it. As explained in the last chapter, the band is the unit of range-sheep operation. The bands are made large enough to keep one herder busy, but not so large

that losses from straying or from attack by coyotes, wolves, and bears become too serious. The herders are assisted by camp tenders who bring them supplies and move their camps from one place to another as necessary. The sheep herders control the movements of the bands under their direction and are thus responsible for the best utilization of the available feed.

Sheep ranches and farms do not grade into each other almost imperceptibly like cattle ranches and farms. The enterprise is either a ranch, or a farm with a flock of sheep. Farm flocks in the Great Plains are like farm flocks of sheep elsewhere in the United States. They come in all sizes less than band size.

TYPES OF SHEEP RANCHES

The sheep ranches of the West can mostly be put in five classes. By far the most common are the year-round-grazing ranches of the great Intermountain region. Under this type of organization, the sheep migrate on the average about 100 miles from summer to winter range. They are lambed in late April or early May and shorn about a month later. The lambs are sold in late summer. Typically, these sheepmen own a sizable area of range land, perhaps rent some from private owners, and for the rest use federal range, either in national forests or in grazing districts.

In the second type of sheep-ranch organization, the sheep are fed hay in sheds or feed lots rather than grazed in the winter. This type is found in western Montana and similar areas where the winter snows are not too deep, but still winter grazing ranges are not available. The sheep are lambed generally in March, and shipped to market usually by midsummer. Such ranching involves less migration than the first type.

The third type of sheep-ranch organization, found particularly in California and Arizona, is more nearly in the nature of feed lot farming. The lambs are born in late fall and fattened for the spring market after grazing on grain fields in the Sacramento Valley of California, or on the alfalfa fields in the Salt River Valley of Arizona, and on the mixed barley and alfalfa fields of southern California.[1] In some sections, they graze on winter range. The lambs are mostly sold in April, particularly in time to hit the Easter markets of the Midwest and the East. In California, the ranchers commonly purchase a major part of their ewes from range operators. They buy older ewes which cannot travel satisfactorily on the range, but which produce lambs for a year or two under these conditions. The production of early lambs is a relatively expensive type of

[1] Robert F. Miller, *Sheep Production in California*, California Circular 49, 1942.

operation, but ordinarily the prices are enough higher to cover these extra costs and more.

The fourth type of sheep ranching combines sheep with cattle and goats on the Edwards Plateau in southwestern Texas. This area carries roughly one fifth of the range sheep of the United States, and more sheep than all of the other Plains areas combined. The grazing is on a year-round basis, and the sheep are run in the same pastures with the cattle and goats. These three types of livestock make more complete utilization of the different types of feed than would any one of them. Nearly all of the land in this area is in private ownership, although some of it may be rented. The investment in grazing land runs to well over $100 per animal unit. The sheep are of the fine-wool breeds, and more emphasis is put on wool than on lamb production. The lambs are ordinarily kept till one year of age and shorn before sale.

The fifth type is the mixed sheep-and-cattle ranching found throughout the range area. On part of the ranches, the cattle and sheep are run as wholly separate enterprises, competing for the attention of the rancher but otherwise nearly separate. On others, the two types of livestock are kept to make joint and more complete use of intermixed forage types on land owned or controlled by one rancher. These mixed ranches present a great diversity in organization and operation.

Although in general the five types of sheep ranching are distributed as just indicated, wide differences may be found within a range of a few hundred miles depending mainly upon rainfall and altitude. Thus, in the interior valleys of California, the sheep are kept on the same land the year round, those in the adjoining foothills are moved to the national forests for summer grazing, and those in the mountain areas are winter-fed on ranch-produced hay in the high mountain valleys.

A MOUNTAIN RANCH

Let us stop at this point and examine in more detail some one ranch, one of the year-round type described above, located in a mountain area. It has four summer and two winter bands of sheep. One summer band consists of yearling ewes being raised for replacement and of dry ewes which do not have lambs. The other three bands are ewes with lambs. The four summer bands contain from 4,000 to 4,400 mature sheep, and three of the summer bands 3,000 growing lambs as well. This ranch is of somewhat more than average size, but it is a representative mountain sheep ranch in other respects. After the lambs have been sold in the late summer, the four bands are combined into two winter bands. The

headquarters ranch has 200 acres of wild hay which is fed to a few head of cattle and to the horses necessary for the operation of the ranch, as well as sometimes to the sheep. This rancher also owns about 20,000 acres of range land, some of which adjoins his ranch and some of which is located at various points along his route of seasonal operations. He rents additional range land, the acreage of which varies somewhat from year to year, but averages perhaps 10,000. He has a permit to graze 2,000 mature sheep on the National Forest from about July 1st to September 1st; also one to graze 4,000 head during the winter on grazing districts, although he owns some land around water holes in the winter-range area. Much of his range, however, is located in the spring-fall area and is intermingled with federal land in the grazing district, and he has an "on and off" permit for 4,000 head on public land.

As to labor force, each band is handled by a herder, and one camp tender serves two bands. Extra labor is hired for haying and at lambing time, and the sheep shearing is hired on a contract basis. The ranch operator keeps on the move between the ranch and the different bands of sheep. He specializes as manager, it is obvious, but he does not hesitate to perform any of the labor operations necessary during the year, and he is skilled in all of them.

A major hazard of this type of ranch is an occasional extremely severe winter or a blizzard. The winter-range areas cannot be used until there is some snow to supply water for the sheep. A few inches of snow will fall in most years, particularly on the hills, and it remains for weeks in the cold weather. The sheep must find snow at least every few days. They move from the valleys to the hills and back. The main hazard, however, is that in occasional years the snow is so deep that the sheep cannot move about and feed on the low shrubs. Under these circumstances the death losses may be large, even whole bands in rare instances.

This ranch sells around 2,000 lambs each fall, these averaging about 75 pounds. It also sells from 30,000 to 35,000 pounds of wool a year. This meant a gross income of $32,000 in 1944. The major item of expense is the wages of the herders, camp tenders, and extra help with the lambing, haying, and sheep shearing. The other items are supplies for the herders and camp tenders, taxes, grazing fees, breeding bucks, and equipment. These costs are all cash costs, and are relatively inflexible from year to year. They totaled around $27,000 in 1944. Sheep ranches did not obtain increased incomes during the war to the extent that cattle ranches and many other types of farms did. As a result, some breeding flocks were liquidated, some ranchers shifting to cattle and some marginal ones quitting altogether.

MANAGEMENT PROBLEMS

It will be apparent from the foregoing that the organization and management problems of ranches differ from those of the farms we have been considering. Except on the mixed ranches, there is usually no problem of combination of enterprises. Variation in inputs of productive factors is limited to the size of bands, the rate of stocking, the amount of labor for certain seasonal operations, and amounts of supplementary feed. But the management is none the less exacting. If a particular rancher fails to handle range sheep successfully, he is promptly succeeded by someone who can.

The problems discussed following are mainly the typical ranching problems of the first two types of ranches. The feeding of lambs is discussed in Chapter XII.

MIGRATION Sheep could be raised without migration, but then there would be far fewer of them in the world. Even if they are kept the year round on one pasture, they must keep on the move because they eat the forage so much faster than it grows in dry climates. Sheep use the forage of more remote mountain ranges and desert areas than do cattle, and of ranges farther removed from each other, because they can migrate longer distances. This is because they herd better, travel better, and forage better on shrubs and forbs. Some of the seasonal migrations are 300 miles or more. They are generally from the high mountain areas in the Rocky Mountains, or in the Wasatch Mountains of Utah, or from the Sierra-Nevada or Cascade Mountains, to the intervening desert winter-range areas and return. Chart 137 shows some of the more important of these routes. The most concentrated movements occur in central Utah. The narrow trails down from the mountains follow streams and valleys, often public highways, to the annoyance of sheep, herder, and motorists; or they may be confined to fenced driveways alongside the highways. Upon emerging from the mountains, the flocks often must proceed along narrow routes through the farming areas. Upon reaching the winter ranges, the sheep spread out and move more slowly. The return trip in the spring is much the same, except that ewes heavy with lamb move with greater difficulty, and the lambs are not able to travel fast or far. If sheep are sheared at some central point, there may be serious congestion around it.

On summer range, sheep rarely travel more than a mile a day; but when they are on the trail from summer to winter range, they may move 5 miles a day while grazing, and as much as 15 miles when moving

rapidly to another location. The longer movements are difficult for the sheep and frequently result in losses. A sheep rancher tries to obtain a good tract of range for use in the spring when the sheep are lambing. The ewes need to provide their maximum of milk at this time, and the small lambs should not have to travel much.

TENURE To fit together and obtain the use of exactly that combination of types of grazing lands that will provide enough good forage at all seasons but not too much, and extra winter feed if need be, and good

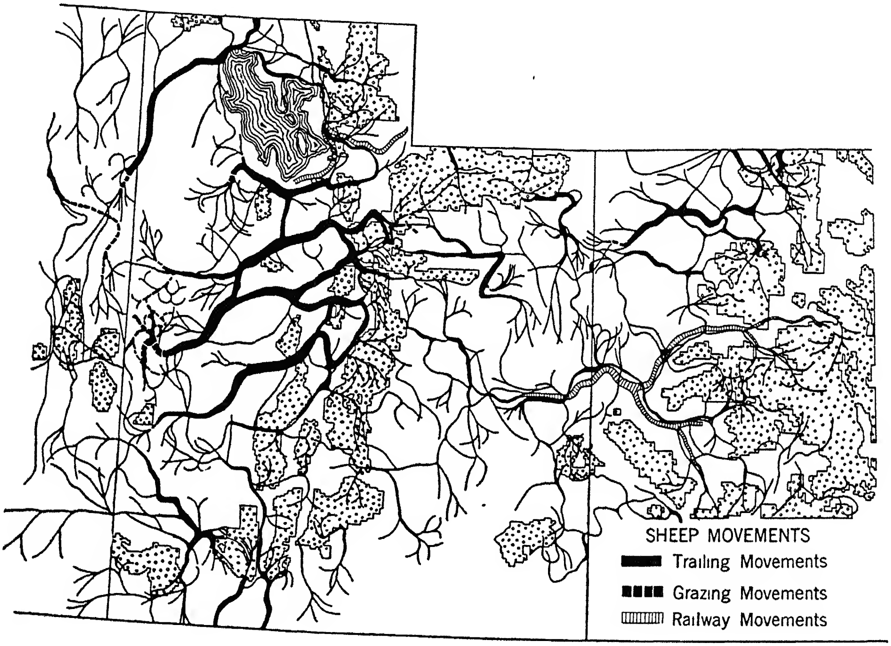

CHART 137. Migration routes of sheep between summer and winter range in Utah and adjoining Colorado. (Reproduced from H. R. Hochmuth, Earl R. Franklin, and Marion Clawson, *Sheep Migration in the Intermountain Region,* U.S.D.A. Circular 624, 1942.)

lambing conditions, for a given number of bands of sheep, obviously presents an extremely difficult problem. One would scarcely believe it could be done if it were not being done in thousands of instances each year. Only because the sheep ranchers have gradually learned how to do it over the years is it possible. The problem is made easier in the mountain areas because a major part of the land is still in federal ownership. If the rancher owns spring-fall range, particularly lambing grounds and shearing areas, and some summer range as well, his problem is

much simpler. Public range may be used at any season, but is particularly important for winter range.

The same problems of commensurability, dependency, fees, etc., arise as with cattle ranches. The commensurability standards have often put more weight on irrigated hay land than these lands ordinarily justify in sheep ranching. In order to secure use of public range, sheep ranchers have sometimes acquired hay meadows which they use only for grazing. The same problems of low fees arise also. Absentee ownership of small tracts, arising from the homestead system, presents a problem also for the sheepmen.

Sheep ranching in New Mexico has one unique form of tenure, the partido system, under which sheep are operated on shares. The renter agrees to return, at the end of the season, the same number of breeding sheep, of the same ages and quality. He assumes all expenses involved in their care; he also assumes all risks, often mortgaging any sheep he may own and accepting personal responsibility for the whole flock as well. The owner of the sheep ordinarily receives, for each 100 ewes, annually 20 lambs averaging at least 55 pounds in weight, to be selected from all lambs weighing above 50 pounds. The renter gets the rest of the lambs and the wool crop. This arrangement works out to give the owner of the sheep from 10 to 15 per cent interest on his capital. The contracts contain numerous clauses which give the owner full protection and the tenant virtually none. This harsh form of tenancy exists because this is an area of limited physical resources, limited capital, high birth rates and little out-migration, so that there is constant pressure of population on the land. Sometimes the contract also includes rental of land from the owner of the sheep.

SIZE OF BUSINESS As indicated earlier, the census data do not give data on sheep ranches separately. The best data on size of sheep ranches are from a study in the Intermountain Region which included 5,000 operators and about one fourth of all sheep in the range region.[2] About a third of the operators had less than 275 sheep; these were mostly in central Utah and south central Idaho where cooperative bands and farm flocks are common. Few of these qualify as sheep ranches, although they do secure some use of public range. About one fourth of the remainder had 275 to 750 sheep — mostly half-band operations. These were most common in the same areas as the smaller flocks. A sheep rancher with approximately half a band in these areas often cares for small lots of sheep owned by others, running them with his to form a full band.

[2] *Op. cit.*

About one fourth of the sheep ranches (excluding those with less than 275 sheep) had 750 to 1,250 sheep — typical one-band outfits. These may not seem like large farms, but the typical one-band outfits had an average gross income of $5,000 to $6,000 in the interwar years.

Less than a fifth of the sheep in this area, however, were in one-band or smaller operations. Another fourth of the operators had more than one normal band, but less than three full summer bands, and the largest fourth had in excess of two bands each, and some of these were very large. Thirty-two owned over 10,000 sheep each, and eight owned more than 25,000 each. Some of these larger operators had cattle as well, and conducted truly large-scale enterprises. This half of the operators had about 80 per cent of the sheep.

Sheep ranches thus tend to concentrate at the lower end of the scale on one full band. Cooperative bands, however, make smaller units possible and frequent. At the upper end of the scale, they tend to concentrate around the number of bands that one manager can supervise effectively. Many sheep ranchers tend to become managers and hire herders to look after their sheep as soon as they obtain two bands. The more bands one manager can supervise, the larger his income, except that losses mount rapidly as soon as a manager spreads his supervision too thin.

RATE OF STOCKING The general problem of the optimum rate of stocking ranges with sheep parallels that for cattle. If summer range is overstocked, lambs will not gain as well as they should and ewes may get in poor condition. Overstocking of winter ranges may lead to weakened ewes, heavy losses in storms, and probably reduced lamb crops. Overstocking of lambing ranges may result in greater losses of ewes and lambs. As in the case of cattle, variations in range forage growth from year to year make it necessary to maintain some margin of reserve or safety.

Within limits, sheep can be made to utilize areas more remote from water, or rougher, than cattle will use of their own volition. But they will inflict greater damage upon a range than cattle if held by the herder too long in one place. The practice now is to move the bed-ground every night or two to keep the sheep from browsing too closely.

As explained earlier, sheep do better relatively than cattle on ranges with a mixture of grasses, weeds, and shrubs. The stocking equivalent of sheep to cattle may be as low as 2 or 3 to 1 on grassy range, but as high as 10 or more to 1 on weedy and shrubby range, with 5 or 6 to 1 as the approximate average. Also, sheep can utilize a brushy but well-

watered range on which the cattle tend to split up into small bunches and the cows to become separated from the bulls, causing low calf crops.

The herding of sheep on the range can be done with a wide variation in efficiencies. The best herding of sheep is the least herding to obtain the results wanted. Sheep should be moved slowly, overlooking no areas, grazing fully but not excessively as they go.

LAMB CROPS Although lamb crops in farm-flock areas often run over 100 per cent, because of twin and triplet births, the average for the seventeen Western range states for the years 1924–1941 was only 80 per cent, compared with a calf crop in the same area and years of 75 per cent. A rancher, let us say, has 2,400 breeding ewes in the fall, but because of winter losses only 2,000 survive to lambing time; and 1,800 lambs are born but only 1,600 survive to the age at which they are castrated and marked. The "gross" lamb crop is 90 per cent, calculated as the number of lambs born divided by the number of ewes at lambing time. The "net" lamb crop, however, is only 67 per cent, calculated as the number of lambs which survive the first few weeks divided by the number of ewes bred in the fall.

The first step in securing a higher "net" lamb crop is thus to reduce the death losses of ewes and lambs. Employing enough extra help in the lambing season is the principal method of reducing lamb losses. Shed lambing, practiced when sheep are fed in winter, requires an investment in sheds and more labor, but the higher lamb crop and the earlier lambing, making it possible to sell perhaps in July rather than in late August or September, may compensate for the extra expense.

The number of lambs born can also be increased by better care of ewes, so that they will be in better condition at breeding time, and also by special conditioning of bucks. Older ewes are often less dependable breeders. However, if prices are low, it may scarcely pay to ship these old ewes to market and the rancher may keep them for whatever he can get out of them.

DEATH LOSSES The death loss in mature sheep in the seventeen states mentioned above and for the same years averaged 8.7 per cent, and for lambs 8.5 per cent, while for all cattle it averaged only 4.5 per cent. This comparison is somewhat misleading, however, since death losses are usually highest among breeding females and young animals, of which the proportion is much higher in herds of sheep. Also, the average loss is lower than the typical because of occasional years of extreme losses. Thus, 5 out of 6 years of record in Nevada had below-average death losses and one year had losses double the average. Deaths may

be due to severe weather, poisonous plants, or disease. Losses from each of these causes can be lessened substantially by more care and better management.

DAY-TO-DAY MANAGEMENT Given a good ranch organization, there still remains a constant succession of jobs to be done right if the ranch operation is to be successful. These include care during lambing, shearing at the proper time and without undue cost, careful herding to avoid losses throughout the year, "bucking" at the proper season, and other similar details. Timeliness is important for nearly all these operations. When winter comes, the herding of sheep into sheltered areas may prevent large losses. These tasks vary not only through the seasons, but may take highly unusual forms. For instance, a severe early storm may catch sheep in an unfavorable location and special help and special feed need to be rushed to them at once, usually over storm-blocked roads, if heavy losses are to be avoided. The ability to make quick decisions and to push action rapidly may be crucial at such times.

It should be apparent that sheepherding is one of the most skilled farm jobs in the West; upon the knowledge, patience, and efforts of the herder and his dog depends much of the success of the ranch operations. In a sense, the herder is on duty 24 hours a day and 7 days a week. He cannot leave his charges without grave risk of serious loss. The development of roads and trails throughout the range area has made it possible for the herders to have small houses on wheels, and the radio has made possible continual contact with the outside world. Many Western sheepherders are foreign-born — Basques, Portuguese, Spaniards, and Mexicans, particularly.

WEIGHT OF LAMBS The weight of lambs sold depends on feed available, climate, and breed of sheep. The milk production of the ewe depends largely upon available feed. When the young lambs begin to feed themselves, they need succulent feed. They cannot make good use of dry or hard feeds however nutritious. It is because the forage at very high altitudes is succulent that it often grows excellent lambs. Some ranges lack the forage needed to produce heavy choice lambs. Lambs from the Southwest are generally lighter than those from the better ranges of the Intermountain area because the climate is warmer. This is a factor not within the control of the rancher; he adjusts to it by greater emphasis upon wool production, which is less affected by climatic conditions.

WOOL OR LAMB Forty or more years ago, wether lambs were held in the flock solely for wool production, and no meat was sold. Now, both meat and wool are always produced, but the proportions can be varied.

Maximum emphasis upon meat production may mean 80 pounds of meat and 5 pounds of wool per ewe in the breeding herd; with the same feed, maximum emphasis upon wool may mean 50 pounds of meat and 10 pounds of wool per head. In this example, 6 pounds of meat substitute for 1 pound of wool. The principal method of control is the choice of breed of sheep. Sheep of different breeding produce lamb and wool in different proportions, as well as in different qualities. The mutton breeds, like Hampshire or Shropshire, will produce more and better quality meat, but less and coarser wool than Rambouillet or Merino wool-type sheep. Most of the costs are joint, incurred for the benefit of both products. The special expenses are shearing the sheep and hauling the wool to market, and hauling or driving the lambs to market.

As suggested above, the type of range largely determines the emphasis on wool or lamb. In areas with poor range forage, the lamb crop is low and the lambs are light in weight. Such ranches are likely to get the major part of their income from wool, and may specialize in the finer grades of wool. In areas with good range, the sheep rancher is likely to put more emphasis on lamb production and may get two thirds or even more of his total income from lambs. But many ranches have forage which is neither poor nor good, and find deciding which way to turn one of their major problems.

Not long ago, most range ewes were of the Rambouillet breed. Then in order to obtain a somewhat larger and meatier type of animal, but still with good wool-producing qualities, ewes from a Hampshire or Shropshire cross on Rambouillet ewes came to be used. A second generation cross of these ewes with a Hampshire, Shropshire, or similar mutton-type buck produced a good market lamb. But this type of operation is difficult, especially for the small operator. To obtain ewes for replacement, he must either maintain separate bands for this purpose, in some years using wool-type bucks, or buy them at considerable expense. In the last twenty years, the Bureau of Animal Industry of the Department of Agriculture and cooperating agencies have conducted sheep-breeding experiments at Dubois, Idaho, and at other locations in the West, and have developed new breeds known as the Columbia and Panama, which retain most of the good wool-producing qualities of the Rambouillet and at the same time are larger, blockier, and better meat producers. Their use generally by ranchers will increase meat and wool production.

METHODS OF HANDLING THE BREEDING FLOCK Some of the more difficult problems of sheep-ranch management center around the handling of the breeding flock. The rancher has to choose between buying

his replacement ewes or raising them, and in either case, decide upon the rate of culling and replacement. Let us analyze these alternatives with some care.

We have already noted that the small rancher finds it difficult to raise his replacement ewes if he wishes to have second-generation-cross lambs. Let us take the case of such a rancher with one band of 1,175 sheep. At present, he is buying 250 ewes each fall and not breeding them until the next fall, and culling out 134 ewes on the average each fall. The difference of 116 is his death loss averaging 10 per cent per year over the six intervening years. He considers as an alternative not selling these 134 ewes — they bring him only $3 each in the market — and breeding them as long as they live. Table 99 shows the composition of the breeding flock under these alternative programs. Actually, of course, the rancher will not make his change from one of these programs to the other in one year. The first year of the new policy, he will need to buy only replacements for 116 ewes; the second year, 129; the third, 150; and so forth, until replacements and death losses balance at 189.

TABLE 99. AGE COMPOSITION OF BAND OF 1,175 SHEEP, UNDER TWO ALTERNATIVE REPLACEMENT PROGRAMS

Age of ewes in fall (years)	*Death loss — per cent*	*Net lamb crop — per cent*	*Number of ewes, selling culls at 6½ years*	*Number of ewes, replacing death losses only*
½	10	0	250	189
1½	10	80	225	170
2½	10	90	203	152
3½	10	90	183	137
4½	10	90	165	123
5½	10	80	149	111
6½	20	70	—	100
7½	30	60	—	80
8½	30	50	—	56
9½	50	40	—	39
10½	100	30	—	19
Total	—	—	1,175	1,175

Which program will net him the most income? Table 100 answers this question with replacement lambs costing $6 and old 6½-year ewes selling at $3, and with the same price for wool and lambs and the same labor and other expense in both programs. In the intervening years while the rancher is buying fewer replacements, he will have a higher net income,

because he is selling some of his capital. By the fourth year, however, his income will be less than under his present program. And when his ranch is fully converted to the new basis, he will receive $368 less of net income. Under pressure, of course, or with the prospect of declining prices, a rancher might advantageously cash in for a year or so by following the alternative plan. But he would want to shift back later.

TABLE 100. PRODUCTION, RECEIPTS, AND VARIABLE EXPENSES FOR A BAND OF SHEEP OPERATED UNDER THE TWO PROGRAMS OF TABLE 99

Item	*All ewes culled out at $6\frac{1}{2}$ years*	*New basis of replacing death losses only*
Total number of ewes	1,175	1,175
Number of ewes bred	925	986
Number of ewe lambs bought	250	189
Number of cull ewes sold	134	0
Number of lambs sold	795	764
Number of sheep shorn	1,115	1,080
Pounds of wool shorn	8,920	8,640
Receipts from:		
Lambs sold	$6,360	$6,112
Cull ewes sold	402	0
Wool sold	2,676	2,592
Total receipts	9,438	8,704
Cost of ewe lambs bought	1,500	1,134
Receipts less variable expenses	7,938	7,570
Other cash expenses	5,000	5,000
Net ranch income	2,938	2,570

By this same sort of budgeting of receipts and expenses, this rancher could test out selling his old ewes at $5\frac{1}{2}$ years, $7\frac{1}{2}$ years, etc. On any particular ranch, the death losses and lamb crop might be different, or the cost of replacements.

Table 101 shows the results of such budgeting applied to the general problem of raising replacements versus buying them, for two one-band ranches, one on poor range and the other on good range. Straight-bred Rambouillet ewes are used when the replacements are raised, but when they are bought, cross-bred ewes are used and crossed again with a mutton-type buck. This second program gives larger and better lambs, but less wool, than the first. Raising their own replacements, these ranches employ a 4-year breeding cycle. The first year starts out with a full band, some of which are yearling ewes and hence not bred. Mutton-type bucks — Hampshire, Shropshire, Oxford, or Dorset — are used,

and all the resulting lambs sold. The second year, all ewes are of breeding age, the same bucks are used, and all lambs sold. By the end of that year, the band is diminished considerably because of death loss. Bucks of breeding similar to that of the ewes are used the third year and ewe lambs saved. This is repeated the fourth year, after which the cycle begins over again. More complicated breeding programs may be used, and in fact are necessary if crossbred ewes are raised, but these are likely to be too involved for single-band outfits.

TABLE 101. PRODUCTION, RECEIPTS AND EXPENSES FOR TWO SHEEP-RANCHES, ONE ON POOR RANGE AND THE OTHER ON GOOD RANGE, WHEN RAISING THEIR REPLACEMENTS AND WHEN BUYING THEM

Item	*Poor range*		*Good range*	
	Raise own replacements	*Buy replacements*	*Raise own replacements*	*Buy replacements*
Number of ewes in fall — total	1,022	1,175	1,090	1,175
Number of ewes bred	870	891	980	924
Net lamb crop — per cent	80	80	90	100
Lambs raised	696	713	883	924
Lambs sold	583	713	774	924
Ewe lambs bought	0	284	0	251
Old ewes sold	5	75	0	106
Wool shorn — pounds per head	10	8	10	8
Wool shorn total	9,458	8,696	10,352	8,176
Death loss — per cent	15	15	10	10
Weight per head of lambs sold	60–65	70	65–70	80
Price per pound of lambs sold	6.0–7.0¢	8.0¢	6.5–7.5	8.5¢
Price per head of lambs sold	3.60–4.50	5.60	4.20–5.25	6.80
Old ewes sold, per head	2.00	3.00	——	3.00
Ewe lambs bought, per head	——	6.50	——	6.50
Price per pound, wool sold	30¢	25¢	30¢	25¢
Receipts: lambs sold	$2,300	$3,992	$3,755	$6,285
old ewes sold	10	225	——	318
wool sold	2,837	2,174	3,106	2,044
Total	5,147	6,391	6,861	8,647
Ewe lambs bought	——	1,846	——	1,631
Receipts less variable expenses	5,147	4,545	6,861	7,016
Other cash expenses	4,000	4,000	4,500	4,500
Net ranch income	$1,147	$545	$2,361	$2,516

The estimates for these ranches when raising their own replacements are averages of the four years in the breeding cycle. The receipts especially vary greatly in the four years; for example, for lambs sold on the

good range, from \$4,995 the first year to \$2,227 the third year. This means that in two of the four years on the poor range, the ranch would have cash-income deficits.

On the poor range, the death losses are fairly high, the lamb crop only fair, and the lambs are light. Nearly all the ewe lambs which can be raised on this breeding program are required to maintain numbers, and only a few old ewes are sold. Average income from lambs is only 60 per cent as much as if replacement ewes were bought. Wool income is somewhat higher, but gross receipts are less. When the cost of purchased replacement ewes is deducted, however, the raising of replacement ewes returns \$600 more income. On the good range, if the ranch raises its own replacements, it has ewe lambs to sell after replacing the death losses of ewes. The lamb crop is accordingly less than if replacements are purchased and culling is heavier. On this range, it pays by a margin of \$150 to buy replacement ewes. Again, it is assumed that operating costs are equal. This comparison illustrates the point made previously, that emphasis upon wool is more profitable on poorer ranges, and upon lamb production, on the better ranges.

The estimates in Table 101 must be taken as illustrative, but they represent a common situation fairly accurately. Any particular ranch needs, however, to use its own production rates and take account of the probable longer-run price outlook.

MIXED RANCHING PROBLEMS

For our discussion of mixed ranching, we shall consider only that of the Edwards Plateau of Texas. The mixed ranching of other sections involves few problems that we have not already discussed under cattle ranching or sheep ranching. If a rancher owns or has the use of a large block of range land with diverse forage, he will get fuller use of it by letting the cattle eat the grass and the sheep the shrubs and forbs. The proportions mainly depend on the type of range and relative prices of cattle, lamb, and wool.

Most of the special features of the Edwards Plateau region have already been pointed out. It should be added that the land is mostly owned in large blocks suitable for ranch operations. The area was fortunate in avoiding the homesteading-dry-farming cycle. And although the cattle, sheep, and goats are fenced in on the same range, the cattle choose the nearly level or gentle sloping grass-covered areas, consuming the taller and more mature grasses, and the sheep prefer gently rolling land or level lands, but make good use of weeds and short grasses on

these lands. Sheep use steep lands only when forced to do so. The goats prefer browse, but will eat grass and weeds, and they feed on the steeper and rougher areas. A common expression is that, "sheep stand on their heads, and goats on their hind legs, to graze and browse." These preferences for feed are relative, not absolute. Somewhat more feed will be obtained from the same area by grazing all three classes of livestock on it. Within rather wide limits, however, shifts can be made from one class of livestock to another without serious loss in the amount of feed harvested. Under these conditions, relative prices of different products sold and costs of operation will determine the most profitable proportions of the various classes of livestock.

The wolf-proof fences are rather expensive — nearly $500 per mile, or nearly $1 per acre for the large fields commonly used, and perhaps an annual cost of $1 to $2 per animal unit in replacing posts, and as interest on the capital invested. Labor inputs are about one to $1\frac{1}{4}$ days per head of cattle, about one third day per sheep, and about one half day per goat. This is about one half to one third as much labor for cattle as in the areas of winter feeding, but about the same as in the other Southwestern year-long cattle-grazing areas. It is only half to a third as much labor as is required for sheep in areas where they are herded and grazed or fed in the winter.

The method of analysis of the problem of balancing cattle, sheep, and goats on one of these ranches is well exemplified in a study by Gabbard, Bonnen, and Tate. The fairly large ranch used in their analysis was running cattle and goats in 1930. Most ranches in this area have sheep also; in fact, the trend is toward more sheep and goats and fewer cattle. The second column in Table 102 shows the effect of substituting some sheep for cattle and goats, keeping the total number of animal units constant. The cattle and goat numbers were cut more than in half, and nearly 2,400 sheep were added. The table shows increases in labor, feed, and maintenance expenses, but much larger increases in receipts. An animal unit of sheep produces considerably more meat, of slightly greater value per pound, than cattle; goats produce about as much meat as sheep, and hence more than cattle, but the value per pound is not much over half as great. However, sheep produce wool and goats mohair, so that the gross income from an animal unit of these livestock is much greater than from an animal unit of cattle.

A comparison of rates of stocking on this ranch and on neighboring ranches indicated that 16 per cent more livestock could be kept without damage to the range forage. The third column in the table shows the effects of adding this 16 per cent all in sheep. The operating costs would

be increased about 10 per cent, gross receipts about 20 per cent, and net returns about 25 per cent.

TABLE 102. ACTUAL AND TWO REVISED ORGANIZATIONS OF A 10,560-ACRE RANCH ON THE EDWARDS PLATEAU OF TEXAS

Item	*Actual organization*	*Revised organization*	
		Same stocking rate, but sheep added	*Increased stocking, and sheep added*
Number of cattle	433	200	200
goats	2,016	882	882
sheep	0	2,394	3,100
Animals sold — cattle	165	85	85
goats	640	383	383
sheep	0	1,220	1,582
Income from animals sold — cattle	$5,470	$2,880	$2,880
goats	1,968	1,185	1,185
sheep	0	6,978	9,048
Income from mohair sold	$5,978	$2,982	$2,982
Income from wool sold	0	6,320	8,184
Total income	$13,416	$20,345	$24,279
Labor: days	1,290	1,534	1,772
cost	$2,361	$2,807	$3,243
Cake purchased: tons	11½	13	15
cost	$462	$529	$614
Miscellaneous costs	3,942	4,408	4,748
total costs	6,765	7,744	8,605
Net returns	$6,651	$12,601	$15,674

Source: Adapted from Tables 8 to 10, Texas Bull. 413, *Planning the Ranch for Greater Profit*, by L. P. Gabbard, C. A. Bonnen, and J. N. Tate, 1930.

It is not possible to tell from the study whether this third organization is the optimum organization for this ranch. Perhaps some other balance of cattle, sheep, and goats would have paid better. The data suggest this strongly, since at the prices reported for 1930, and in the proportions in which they were combined on this ranch, sheep returned most above direct costs chargeable to them, goats came second, and cattle were a poor third. Substitution of sheep for either cattle or goats, or both, increased net returns. The very essence of mixed ranching in this area

is the supplementarity in use of range forage as between the classes of livestock. At some set proportion between cattle, sheep, and goats, the three will be equally profitable on any ranch. To determine this proportion is the object of the analysis. For this determination, more complete data are needed than were reported in this study.

FURTHER READING

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*James T. Jardine and Mark Anderson, *Range Management on the National Forests*, U.S.D.A. Bull. 790, 1919.

*K. P. Pickerell and E. B. Stanley, *An Economic Study of Range Sheep Production in Arizona*, Arizona Bull. 134, 1930.

*M. H. Saunderson and Louis Vinke, *The Economics of Range Sheep Production in Montana*, Montana Bull. 302, 1935.

*A. F. Vass and Harry Pearson, *Range Sheep Production on the Red Desert and Adjoining Areas*, Wyoming Bull. 158, 1927.

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CHAPTER XLVI

The Management of Farm Woodland

THE ASSIGNMENT FOR THIS CHAPTER IS TO ANALYZE THE MANAGEMENT problems of farm woodland as such, and those arising out of the combination of crop growing, grazing, and timber production on the same farm. In the brief space available, only the more general aspects of these problems can be covered. The procedure followed will consist, first, of analysis of the management of a small assortment of farms with more or less timber, in the East and South, that will serve to illustrate the methods of analysis.[1] Then will follow several examples of analyses on an area basis. The farms and areas will range all the way from those whose only timber is fuel wood for the farm family to those in which all of the cash receipts come from timber sales, the farming consisting only of production of feed for the workstock and a family cow or two.

THE EXTENT OF FARM WOODLAND FARMING

The importance of farm woodland management may be indicated in part by the simple facts as to the area of such woodland. The 1930 general census reported 150,000,000 acres of woodland on farms in the United States; the 1935 Special Census on Agriculture, 185,000,000 acres; and the 1940 general census, 137,000,000 acres. Many units of land counted as farms in 1935 were omitted in 1930 and 1940 because they did not have much agriculture on them. One half of this woodland in farms is woodland pasture. The best available estimate for privately owned woodland not in farms in 1935 was 200,000,000 acres. The 40,000,000 acres, more or less, counted out in 1940 must be added to these 200,000,000 acres if it is not included in farm land. Our concern in this chapter is only with the woodland that is within farms. But it is worth noting that the 200,000,000 acres considered not in farms in 1935 was owned by 880,000 separate owners, an average of 230 acres per owner, and only 3,500 of

[1] The authors are familiar with no examples of such analyses of farm woodlands in other sections of the country.

these owners held tracts of 5,000 acres or more. Except in certain areas, the privately owned timberland of this country is therefore held in about as widely dispersed ownership as the farm land.

According to the census enumerations, the peak in woodland in farms in the country was from 1880 to 1900 at around 190,000,000 acres. The new farms created since 1880 have been largely in the Great Plains and have not included much timberland, and the farms in the Midwest have cleared considerable land in the past fifty years. The method of clearing in this period has been in the main the cutting of the timber for fuel wood and pasturing the land until the hardwood stumps have rotted, or pasturing may also have caused the trees to die as tight bluegrass sods have formed under them.

In the Northeast especially, considerable land has reverted from cropland and pasture land to woodland, beginning even before 1800, but mostly since 1860; Chart 138 presents the best available data as to the amount of this in the six New England states. The acreage of woodland in farms changed very little because of this, since farms were abandoned about as fast as cropland and pasture reverted to timber. Agricultural land is here defined as cropland plus open pasture. This plus farm woodland makes up all of the land in farms except for a small amount of "other land in farms," which consists of waste land, farmstead, roads, lanes, etc.

The 1940 census data on the value of the forest products of farms include only products sold — the figure is \$39,152,000, including maple syrup and sugar. The parallel 1929 figure is \$100,000,000, plus another \$142,000,000 for forest products used on the home farm. The 1929 figure obviously represents a much more complete enumeration. The 1929 figure is divided 62 per cent firewood, 20 per cent saw logs, and veneer logs, and the rest about equally between fence posts, pulpwood, railroad ties, and poles and pilings.

The 1939 census, however, has more complete data than the 1929 for the farms classified as *forest-product* farms because of having forest products as their major source of income. The 23,300 of these had an average gross product of \$1,110, of which \$670 was from forest products, \$170 from products of household use, \$160 from livestock and livestock products, and \$110 from crops. These forest-product farms are concentrated mostly in central New England, the southern Appalachians, certain sandy areas of the South, the Ozarks, and the cutover areas of the Lake states, of northern Idaho, and of the northwest Pacific Coast. The 1939 census reported 253,000 other farms as receiving an average of \$93 from sales of forest products. The woodland on two million other farms supplied timber products only for use on the farm.

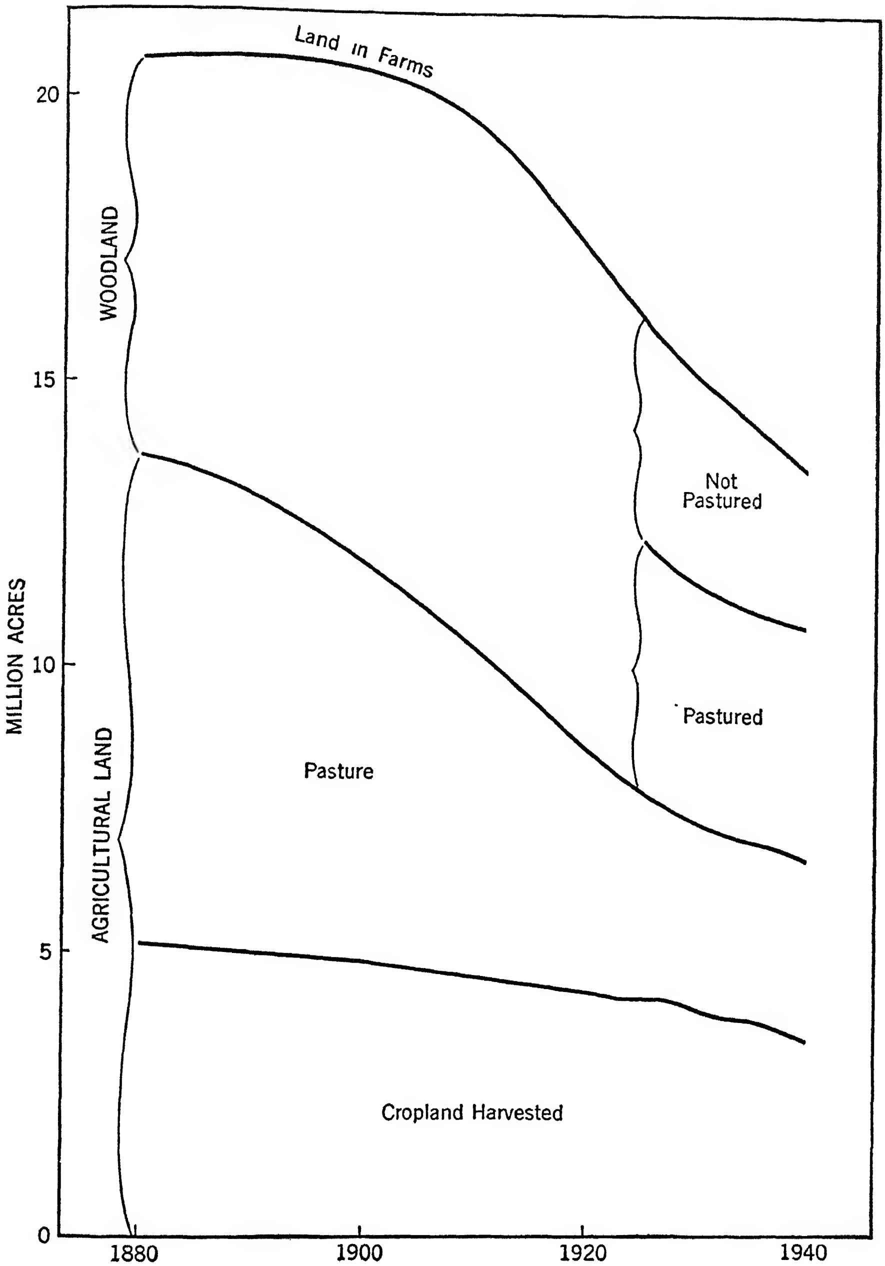

CHART 138. Changes in land in farms, farm woodland, pasture land, agricultural land, and cropland, 1880 to 1940, New England states. (Constructed by fitting together federal and state census reports, from an unpublished manuscript by John D. Black.)

THE NATURE OF THE MANAGEMENT PROBLEM

We shall be assisted in our analyses of the problems of particular areas if we first obtain an insight into the general character of the problems of farm woodland management.

The first major decision to be made on a farm with woodland is what land to keep in timber instead of pasture, woodland pasture, or crops. The decision involves, on the one hand, the suitability of the land for the different uses because of topography, stoniness, drainage, and composition, texture, and structure of the soil; and on the other, the market for timber, the needs for timber products on the farm, the relative proportions of different kinds of land on the farm, and the acreage of good arable land in the farm. A common assumption is that the physical character of the land destines certain land to be in timber and that all other land should be "put to a higher use." In fact, however, a large fraction of the woodland in farms in the northeast quadrant of the United States could be used for permanent pasture if it were cleared and limed and fertilized occasionally, and would be so used if it were in Europe, if not used as cropland. And erosion can be stopped on many of the relatively steep hillsides of the South by planting them to kudzu or sericea. From a fifth to a half of the land in half the farms in the United States is sufficiently in a border zone between use as pasture or hay or timber so that it needs to be shifted from one to the other with changing circumstances of the sort named. The best use of millions of fields or patches of land in these farms needs to be reexamined at intervals. This does not mean shifting them back and forth from one use to the other from time to time; rather the shifting of them from an outdated long-term use to one in keeping with the conditions likely to prevail in the world of the next hundred years or more.

The method of examination best suited to this problem is the familiar one of weighing anticipated receipts and expenditures of the farms with these critical fields devoted to their different alternative uses. But some important new circumstances enter. The first is that land cannot be shifted into timber or out of timber except at great expense, and once it is in timber, the *full* harvest may be anywhere from 25 to 125 years away. Decisions therefore need to be made a long ways in advance. And none of us can know about demands and prices for timber products very far into the future. The procedure followed in such budgeting is usually to assume that prices of timber products and wage and other cost-rates will remain in the same relation to other prices as in some more

or less stable recent period, like 1935–1939. Such an assumption is usually considered conservative, because timber product prices are expected to rise relative to others as virgin stands approach still nearer to exhaustion and populations continue to increase.

Such budgeting also necessarily balances the income that might be received in the next five or ten years if timberland is converted to pasture or cropland, or if potential timberland is left in these uses, against income from timber products to be received only after several decades. These distant future incomes really need to be discounted down to the present before they can be properly compared with immediate income.

Someone may also say that a farmer is not likely to be much concerned over income that he will not receive until several decades hence. The value of growing timber, however, tends to be reflected in the sales price of farms. Therefore, all the farmer needs to do to get back his investment is to sell his farm. In the meantime, or as long as he keeps his stand of timber developing properly, he is increasing his inventory. He is, in fact, reinvesting in his business.

Also, if the decision involves what to do with a present stand of timber that needs treatment, as is more commonly the case, there will usually be some income from improvement cuttings at the start; and in ten years or so, some further income from thinnings. Hence, in practice the income is not delayed as much as above implied.

Such a decision often involves little more than building fences to shut the cattle or sheep out of a tract of woodland so as to give it a chance to reproduce. The investment in building and maintaining the fence, plus the present value of any grazing, then has to be balanced against the timber income later. In most parts of the United States, grazing and timber production interfere with each other seriously. The principal areas where they do not are in the open forests of the southeast Coastal Plain, and on some of the Western forest ranges.

The next set of major decisions relates to the intensity of the silviculture. At one extreme, the timber is left to reproduce itself entirely; a second degree of intensity includes protection from fire, and perhaps disease and insects; a third, protection from livestock; a fourth, light improvement cutting; a fifth, weeding (cutting out such weed species as poplar and gray birch); a sixth, thorough improvement cutting and weeding and subsequent thinnings; a seventh, considerable pruning; an eighth, filling in gaps by planting. Labor supply, wages, and prices will largely determine which of these degrees pays best in any situation. This country cannot afford the intensive silviculture practiced in many European forests.

Problems of a more technical nature, but with some economic aspects, have to do with the choice of species to favor in improvement and weeding operations, or to plant on a particular site; the density of stands; the method of cutting, whether selective, clear cutting by strips, etc.; the method of reproduction; the age at which trees are cut; methods of disease and pest control; and the form in which to market.

Another important aspect of the problem is the general lack of silvicultural knowledge and skill among the farming population of this country. Farm workers may have skills in the use of the axe and saw, or in getting logs out of the forest, but little in the growing of trees. Extension teaching in forestry has made small headway as yet.

On much of the farm woodland of the United States, the economy of any form or degree of silvicultural practice is contingent upon the supply of labor on the farm. If improvement cuttings, weedings, and thinnings can be made by the regular farm labor force in the winter time, or in late autumn before the snows come, without hiring extra labor for it, they will increase the farm income importantly over the years at little additional cash outlay, and steadily build up the value of the farm. But if this labor is hired, or if labor done by the regular labor force is charged as an expense at hired-labor rates, these operations stand a good chance of showing a loss. The major consideration is, therefore, the availability of labor on the farm, and the values of the competing alternative uses.

ANALYSIS OF SAMPLE FARMS

The nature of the foregoing problems and several others will become more evident as we proceed to study actual examples of farms combining crop, livestock, and timber production.

DAIRY-WOODLAND FARMS, WORCESTER COUNTY, MASSACHUSETTS [2] About 70 per cent of the land in Worcester County is now in timber of one sort or another, part of it pastured woodland. Some saw timber and posts are still cut, but most of the timber is cut for cordwood. The particular farms considered are toward the western edge of the county, in a town that was settled around 1740. By 1830, around two thirds of the land in this town was cleared of trees and perhaps half of this was tilled land, and the rest was stony pasture land. The decline in agriculture that set in after 1830 had by 1930 reduced the population of the rural towns of

[2] This analysis is based upon a not yet published manuscript of a land-use planning study of Worcester County made jointly by the Massachusetts Agricultural Experiment Station, Harvard University, and the United States Department of Agriculture. The part of the study here drawn upon was largely the work of Gordon L. Chute.

Worcester County by a half or more. The small local industries that had sprung up from 1750 to 1830 had mostly disappeared, and much of the pasture land and some cropland had gone back to trees. Usually the first timber growth, especially on the old fields, was a dense stand of white pine, known as "old-field pine." The original forest was mainly hardwood — red and white oak, chestnut, sugar maple, yellow birch and ash, with red maple and elm on the damper sites. The conifers were white pines, hemlock, and red spruce. The old-field pine was logged for box wood, usually around 1880 to 1920, and was succeeded by hardwoods, which if left to themselves would usually have made fairly good forest in a hundred years or so. The weed species coming in strongest at the start — gray birch, poplar, and pin cherry — would have given way to the more persistent hardwoods of the original forest.

Usually, however, the hardwoods, while still largely weed species, were cut for cordwood, and were succeeded by trees largely developed from sprouts on the hardwood stumps. These sprouts grow faster than the saplings derived from seeds and dominate the stands if left to themselves; and the timber they produce is mostly fit only for cordwood. Hence, the present product of these timberlands is mostly fuel wood. Another large part of the farms in the county is still in pasture. If it has been limed and fertilized from time to time, and if the gray birch and brush have been kept cut, it is still productive pasture. But much of it is the poor brush and woodland pasture found on the Massachusetts farm that was replanned in Chapter XXVIII.

Although the hardwoods that follow old-field pine will make a fairly good forest if left to themselves, they will make a better forest in much shorter time if weeded when around 5 to 10 years old and again at 12 to 20 years, and if beginning at 25 to 30 years the remaining trees are thinned at intervals of around 15 to 20 years, until a stand of around 150 trees to the acre is left as the final crop trees.

The first farm here considered, the field map of which is shown in Chart 139, has more woodland than the usual farm in this locality because of running up onto a steep stony hill on the west side of the farm.[3] The soils on the farm are all Gloucester, except the Whitman in several alder swamps. Its 39 acres of cropland are distributed in six small patches scattered all over the farm. Some of this is still rather stony and some of it must be used for wild hay unless it is drained. The farm has 66 acres in pasture, but two thirds of this is brushy or covered with a thin

[3] This map omits most of the stone fences on this farm. Field C_5 and Field C_6, for example, are each split into 8 separate fields by stone fences. The pasture tracts, P_3 and P_5, are split into 5 and 4 fields. This indicates that they were cropped at one time.

growth of trees. The cattle actually also range over the whole 142 acres of woodland on the farm, but there is so much of it that they have done little damage. The married farm laborer employed on this farm occupies the farm buildings in Field C_5. The net cash income of the farm at 1935–1939 prices was $1,120, derived from receipts of $3,920 and expenditures of $2,800, including $500 for hired labor, $660 for concentrates, $400 for replacement cows, $430 for milk hauling, and $140 for fertilizers and seed. The receipts were all from milk, except $275 from cull cows

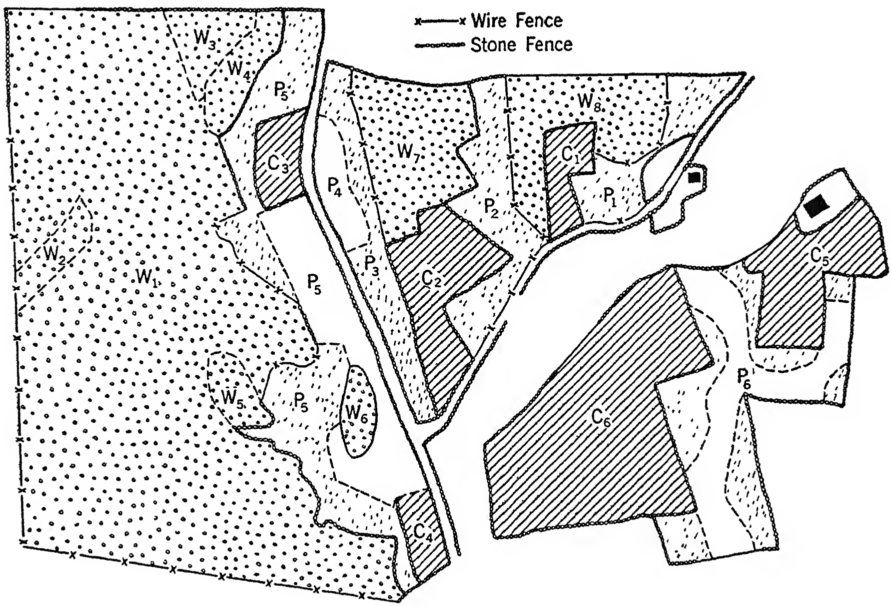

CHART 139. The field map of a 260-acre dairy-woodland farm in Worcester County, Massachusetts.

and calves and $28 from cordwood. Receipts from timber products would have been somewhat larger if the hurricane of 1938 had not forced premature harvesting of some of the stands. This $1,120 is not an adequate return to this family for the management and labor of the farmer and his son.

Table 103 shows the organization of the farm in 1935–1939 and as proposed. The changes proposed in the crop-and-livestock part of the organization are as follows:

A. Convert Field C_3 to improved pasture; it is too stony and subject to drouths for crops.

B. Improve 18.8 acres of pasture in Fields P_2, P_3, P_5, and P_6, to provide

60 per cent more pasture feed, by liming, fertilizing, and seeding to a Ladino clover mixture and cutting the brush on some of it.

c. For all the cropland, except part of Field C_6, a rotation with no tilled crop is proposed, consisting of millet and oats and hay, 5 years. A low-alfalfa mixture is proposed for most of the hay, and a clover mixture for the rest. For the level part of Field C_6, a rotation is proposed of potatoes, oats, and mixed clover-hay three years.

d. The additional pasture feed and roughage thus provided will enable this farmer to raise all his replacements and feed his 21 milk cows enough better to obtain 500 more pounds of milk from them a year, and reduce his feed bills by $50 a year.

The changes in timber management cannot be presented so simply. Table 104 presents the major facts as to the stands of timber in the eight areas in the map. Only one small stand is more than 35 years old, and most of it is 25 years or less. In spite of the clear-cutting and the grazing,

TABLE 103. PRESENT AND PROPOSED ORGANIZATION OF A 260-ACRE DAIRY-WOODLAND FARM IN WORCESTER COUNTY, MASSACHUSETTS

Land Use	*Present*			*Proposed*		
	Acres	*Yield per Acre*	*Total yield*	*Acres*	*Yield per Acre*	*Total yield*
Crops						
Mixed hay	25.6	1.7	42.5	—	—	—
Alfalfa (low)	0.4	2.0	0.8	9 9	2.4	23 4
Wild hay	3.3	1.4	4.6	3.3	1.4	4.6
Silage corn	0.5					
Rye†	1.1	1.0	1.1	(3 8)	2.5	9.5
Oats (hay)	3.1	1.8	5.6	2.9	1.8	5.2
Oats — to pasture				2.0	4.0	8.0
Millet (hay)	2.1	2.2	4.6			
Millet (green)	1.3	7.7	10.0	3 8	7.7	29.3
Potatoes	0.9	89.0	80.0	1.0		
Clover hay				12.8	1.8	23.0
Garden & orchard	0.9			0.9		
Total cropland	39.2	XXX	XXX	36.6	XXX	XXXX
Open pasture imp.	—			18.8		
Open pasture unimp.	25.5			15.7		
Brushy pasture	40.5			36.0		
Wooded pasture	142.0			7.8		
Woodland				132.3		
Other (swamp, idle & homes)	12.8			12.8		
Total acreage	260 0			260.0		

TABLE 103. PRESENT AND PROPOSED ORGANIZATION OF A 260-ACRE DAIRY-WOODLAND FARM IN WORCESTER COUNTY, MASSACHUSETTS (Continued)

Livestock	*Present*	*Proposed*
Cows	21	21
Heifers — 2 yrs.		3
Heifers — 1 yr.	1	5
Calves	1.5	5
Bulls	1	1
Horses	2	2
Brood sows		
Shoats	5	5
Pigs		
Hens	15	15
Chicks raised	80	80
Total animal units (roughage)	23	26

Labor on farm

Present		*Proposed*	
Family	*Hired*	*Family*	*Hired*
2	1.3	2	1

Miscellaneous

	Present		Proposed	
Milk production per cow	Present	5960	Proposed	6460
Replacements purchased	Present	1	Proposed	. . .
Hay purchased	Present	. . .	Proposed	. .
Animal units per crop acre	Present	.6	Proposed	.8
Animal units per man equivalent	Present	7.5	Proposed	8.8
Dollars per crop acre for seed, fertilizer, and lime	Present	2.74	Proposed	6.60

Comments:

Present total feed production = 125,286 T D N
Proposed total feed production = 135,786 T D N

Source: This part of the analysis was made under the direction of George W. Westcott of Massachusetts State College.

† Hay at present; pasture proposed.

enough sound straight hardwood trees are left on the better-hardwood stands to make a final harvest of good volume and quality. The softwood stands have seeded in on run-down pastures. For the better-hardwood stands, improvement cuttings spread over the years are proposed. These should reduce the red maple, which is a less valuable species, and also the red oak, because it is a favored food of the gypsy moth which causes much damage in this area. For W_4, the gray birch is to be gradually removed to release the white pine seedlings that are coming along under it. The softwood tract W_6 is to be allowed to return to pasture. Fences are to be built to supplement the existing stone fences as indicated in Chart 139. The cash outlays for this fence will be $100, the farm furnishing the posts and labor.

TABLE 104. TIMBER STANDS ON FARM DESCRIBED IN TABLE 103 AND CHART 139

Stand no.	*Land-use class*	*Cover type*	*Age*	*Acres*
W_1	Better hardwood	Red oak, white ash, red maple	25	109.1
W_2	Better hardwood	Red oak, white ash, red maple	50	2.2
W_3	Better hardwood	(Formerly white pine, red oak, white ash, red maple — pine destroyed and salvaged)	15	3.2
W_4	Inferior hardwood	Gray birch	15	2.5
W_5	Softwood	White pine	20	2.5
W_6	(Formerly pine.	Destroyed and salvaged)	0	1.9
W_7	Better hardwood	Red maple swale	30	10.6
W_8	Better hardwood	Red oak, white ash, red maple	35	10.0
			Total	142.0

The improvement cuttings will require about 160 man-days of labor a year over the next ten years, which is more than the regular labor force can provide. They will, however, yield 1,060 cords of fuel wood, and 3 M B F of saw logs,[4] which at 1935–1939 prices would sell for $3,550. This will pay for the extra labor hired and leave a net return of $235 per year.

Table 105 presents a summary of the receipts and expenses of this farm by 5-year periods for 70 years. From the tenth year through the fiftieth, the woodland is expected to yield, from thinnings, fuel for the farm family, estimated at 18 cords, and fence posts and other timber for the farm, and from $136 to $255 of net income per year. The regular farm labor force will be able to do all the work. From then on, the cuttings will increase as the stands need to be opened up further to give the tops of the final crop trees a chance to expand, by removing trees already of saw log size. Extra labor will need to be hired, but sales will be heavy for several decades. Then they will decline gradually to the sustained-yield normal of $778 a year, which the farm labor force can handle except for $114 a year of hired labor. The net farm income at this stage will be $2,214, which is double the present income. Most of the increase will have come from improving the woodland.

Before this particular reorganization was chosen, several alternatives were analyzed. Those for the dairy part of the farm involved additional

[4] M B F = thousand board feet.

TABLE 105. FINANCIAL SUMMARY OF PROPOSED FARM ORGANIZATION IN TABLE 103 BY 5-YEAR PERIODS

Five-year periods	*Main-farm enterprise*		*Woodland*		*Total farm*		*Net cash income*
	Cash receipts	*Cash expenses*	*Cash receipts*	*Cash expenses*	*Cash receipts*	*Cash expenses*	
1	$4,164	$3,009 [a]	$322	$194	$4,486	$2,903	$1,583
2	4,164	2,914	388	248	4,552	2,862	1,690
3	4,164	2,914	145	—	4,309	2,614	1,695
4	4,164	2,914	136	—	4,300	2,614	1,686
5	4,164	2,914	150	—	4,314	2,614	1,700
6	4,164	2,914	185	—	4,349	2,614	1,735
7	4,164	2,914	255	—	4,419	2,614	1,805
8	4,164	2,914	173	—	4,337	2,614	1,723
9	4,164	2,914	176	—	4,340	2,614	1,726
10	4,164	2,914	690	91	4,854	2,705	2,149
11	4,164	2,914	817	145	4,981	2,759	2,222
12	4,164	2,914	2,245	737	6,409	3,351	3,058
13	4,164	2,914	2,243	727	6,407	3,341	3,066
14	4,164	2,914	2,365	782	6,529	3,396	3,133
When woodland is fully productive	4,164	2,914	778	114	4,942	2,728	2,214

[a] Expense for pasture improvement will average about $190 annually during the first five-year period, and maintenance cost thereafter will average about $95 per year.

capital investments in clearing stones from land to increase the cropland and improving more pasture at the same time. No easy way of getting stones out of the land had been discovered in 1940; and no cheap way is in the immediate prospect. Furthermore, there would be no object in having more cropland and pasture unless the barns were enlarged to hold more cattle. Grain can be bought cheaper than it can be produced in New England. With new milking techniques, this farmer might be willing to enlarge his barn and keep more cows. He was not willing to consider it in 1940.

The woodland alternatives analyzed included a cordwood cutting program on the hardwood stands, with saw logs only in the softwood stands, and selling 62 acres of the timberland so that the regular farm labor force could handle the rest, but managing the 80 acres about as outlined. The first of these would return $430 less than the one chosen; and the second, $300 less.

This farm has more woodland than most of the dairy farms of New England, but apparently not more than can be handled to advantage.

Four other farms analyzed in the same town had, respectively, only 18, 31, 43, and 46 acres of woodland. This was less than three of them could handle to good advantage. The reorganization plans for these called for converting, respectively, 29, 27, 5, and 18 acres of brushy pasture by shutting the cattle out and letting natural reproduction have its way, and if this did not suffice, doing whatever planting was needed. The plan for the third of these called in addition for the buying of 25 acres of young hardwood stand.

The resulting 47 acres on the first of these farms would return the farm a net $220 a year and call for only 44 days of labor a year. Pasture improvements and adjustments in cropping and livestock systems would increase the farm income by $1,130. The second farm in the list would have 58 acres of woodland after reorganization, with $266 added to its income thereby, plus $350 from other adjustments, with 41 days extra labor; the third, 73 acres, and $285 added income; and the fourth, 64 acres and $275 more income. The third of these is a farm with 74 acres of cropland that can handle the 25 more acres of woodland to advantage, hiring only $60 worth of extra labor.

None of the reorganizations of these farms is drastic. They mostly leave the field boundaries where they are, and propose scarcely any removals of stone fences, or drainage of lowlands. The dairy herds are enlarged very little, and the pasture improvements are modest. Should market outlets for dairy products expand, most of these farms could be made to increase their output of milk by a half. If timber products were to rise in price strongly in the next few decades, a large expansion of timber output could be projected into the future by converting brush pasture into woodland. The five farms all have a sizable acreage of land more or less idle in the twilight zone between improved pasture and improved woodland. Thus the reorganized farm plan of the 260-acre farm outlined in Table 103 still has 16 acres of unimproved pasture and 36 acres of brushy pasture.

HEARD COUNTY, GEORGIA, PIEDMONT FARMS Woodland plans have been worked out for each of the ten farms in the Heard County[5] planning project. Chart 140 shows the revised plan for one of the farms with existing timber stands sketched in, and Table 106 the program for handling each of these stands. This farm before it was replanned included 62 acres of cropland, 63 acres of woodland, 10 acres of woodland pasture, and

[5] This discussion is based upon W. T. Wilson and J. C. Downing, *Three Years of Experimenting with Farm Reorganization in Heard County, Georgia, 1942–1943–1944*, U.S.D.A., B A E in cooperation with Farm Security Administration, April, 1945.

16 acres of very poor open pasture. The crops were mostly cotton, corn, velvet beans, and oats. The soil map of this farm showed three fourths of it to be either "severely eroded," or "moderately severely eroded." Much of the timberland even was eroded, probably from cropping before it was abandoned. The revised plan calls for shifting out of cotton altogether and establishing of 40 acres of kudzu, 15 acres to be used for hay and the remainder for pasture. The rest of the 35 acres of cropland will consist of 14 acres of grain (corn, oats, hegari) and oats and vetch and lespedeza (double-cropped) for hay. In addition, 30 acres of pasture is

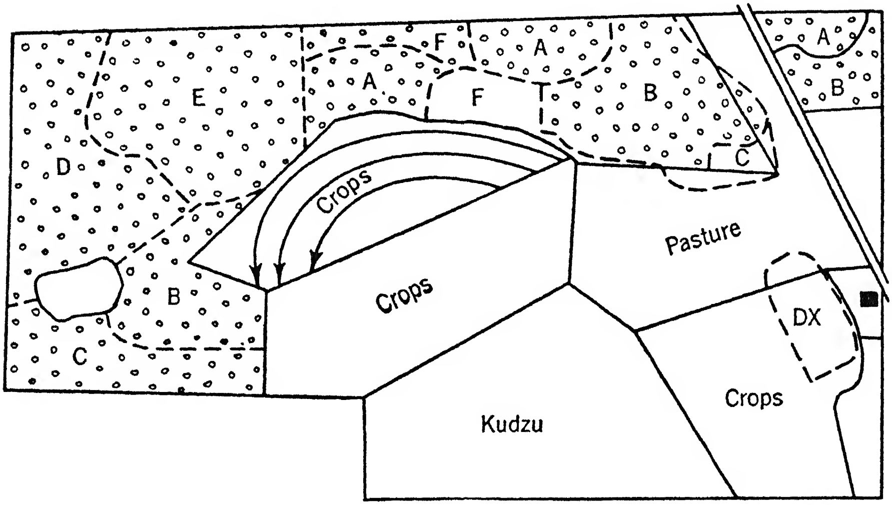

CHART 140. Revised plan of a Georgia Piedmont farm, with timber stands as they were before reorganizations. (This chart combines two in the report.)

to be limed, fertilized, and seeded to a lespedeza, Dallis grass, and Dutch clover mixture. This forage and grain is to be utilized by a herd of 15 beef cows and 2 milk cows and their offspring, 7 hogs, and 50 hens. The calves are to be sold as yearlings. The net cash income from the crop-and-livestock program is expected to rise from $118 to $694 in 10 years at 1941 prices, and $125 of this $694 is expected to come from sales of timber products. Eventually, the timberland is expected to yield $200 a year. The operator of this farm already had his 40 acres of kudzu planted by 1944 and had carried out the planned timberland improvements. This farm received A A A conservation payments amounting to $221 for pasture improvements and kudzu planting in 1943, and to $131 in 1944. Future conservation payments will be much smaller.

TABLE 106. FARM WOODLAND PLAN FOR A FARM IN HEARD COUNTY, GEORGIA

Stand class — *Class*	*Stand class* — *No. of acres*	*Description*	*Establishment of practices. The farmer agrees to:*	*Year work should be carried out*	*Estimated returns 1942–1952*[a]
Entire area		Very little fire damage is evident. Some grazing damage.	Continue protection from fire. Exclude stock from hardwood stands and young pine.	——	——
A	3	Fields, retired and to be retired.	Plant with loblolly pine, 6′ × 6′ spacing, 4,000 trees.	1942 1943	
B	21	Pine saplings and small poles, open grown; trees of low average quality.	Cut rough trees (those that cannot be pruned to produce one clear log).	1944	15 cords fuel wood
			Prune remaining trees.	1945	
			Plant open spaces with loblolly pine, 6′ × 6′ spacing, 7,000 trees.	1946	
C	8	Pine poles, medium and dense stands; larger trees potentially high quality. Some little-leaf disease evident.	Thin, removing diseased trees, rough trees, and additional trees as necessary to encourage good growth on remaining stand.	1943	24 cords fuel wood
			Prune remaining trees.	1944	
D	11	Pine, small saw-timber size, medium and dense stands; larger trees low quality; smaller trees high quality.	Make selective cut for saw timber, removing rough trees, diseased trees, and thinning dense stands where necessary to maintain growth.	1942	25 M feet saw timber 6 cords fuel wood
Dx	3	Same as D.	Same as D; area to be pastured and eventually cleared.	1942	6 cords fuel wood
E	13	Hardwoods, culled-over original growth. Some large, low-quality trees and some excellent poles and saplings.	Make selective cut for saw timber; remove all merchantable red oak and black gum and reserve all thrifty poplar and white oak.	1942	15 M feet saw timber 5 cords fuel wood
			Stand improvement cut to remove cull trees and release desirable trees.	1946	15 cords fuel wood
F	4	Hardwood saplings.	Stand improvement cut and light thinning.	1946	

Total 63 (3 acres to be cleared eventually)	*Pine*	*Hardwood*	*Total*	*Estimated returns*
Stand after saw log cut.	35 M ft.	10 M ft.	45 M ft.	40 M feet saw timber
Estimated growth, 1942 to 1952.	75 M ft.	20 M ft.	95 M ft.	
Estimated stand, 1952.	110 M ft.	30 M ft.	140 M ft.	65 cords fuel wood

[a] In addition, approximately 600 posts were available (February, 1942) in white oak and post oak trees that should be cut; chemically treated pine posts should be used for additional needs.

The 57 acres of woodland on a one-mule farm in this area with only 26 acres of cropland are expected to contribute \$100 a year to a net cash income much increased by shifting from cotton to poultry. The land in timber is fit only for timber except for 8 acres that are to be cleared and planted to kudzu. The timber improvement program parallels that for the preceding farm. On several of the remaining farms in this project, the woodlands are only large enough to provide the fuel wood and posts needed by the farm.

TVA TEST DEMONSTRATION FARMS Some attention is paid to farm woodlands on most test-demonstration farms. In recent years, a few of them have been carefully planned by the methods outlined above for the Worcester County farms. The woodland part of the plan presented following was developed by Gordon Chute in 1941.[6] This farm had 65 acres of open land and 26 acres of woodland when it became part of the TVA program in 1935. In 1937, the family cleared 2 acres of woodland. This has frequently happened on the Tennessee test-demonstration farms; the combination of erosion control and liming and phosphating makes feasible the cropping of land that has been in trees in recent decades. Many of these farms need every acre of cropland they can get — obviously, this one, since its net cash income in 1935 was only \$350. By 1940, this figure had been raised to \$647, principally by better crop yields and pasture improvement. The long hillside south of the road in Chart 141 had been laid out in fields following the contour, and had been cultivated on the contour, but not strip-cropped. Nothing had been done to the woodland north of the wood.

The woodland on this farm in November, 1941, was as follows:

STAND NO.	ACRES	TYPE	SIZE CLASS
1	3.6	Short-leaf pine and upland hardwoods	Small saw timber
2	1.6	Upland hardwoods	Under cordwood (sapling)
3	4.7	Mixed oak and hickory	Saw timber
4	12.4	Short-leaf pine, oak, and chestnut	Saw timber
5	2.0	Short-leaf pine and yellow poplar	Saw timber
6 & 7	1.3	To be planted to black locust	
Total	25.6		

The farm plan developed for this farm in 1941, on the basis of soil mapping and budget analyses of alternatives, should raise the net cash income to \$780, of which \$75 would come from developing the wood-

[6] Tennessee College of Agriculture and the United States Department of Agriculture cooperating, *Progress and Possibilities for Further Progress on 50 Unit Test-Demonstration Farms in the Valley of East Tennessee.* June, 1942. See footnote p. 639.

lands. This would be in addition to the fuel wood, posts, and lumber used on the farm. Fields A, E, J, H, and K_3 are to be kept in improved pasture. Some of these had received no treatment by 1941. The bottom lands in Fields B_1 to B_3 and K_1 are to be used in a two-year rotation with corn and oats-lespedeza and fertilized heavily. The remaining

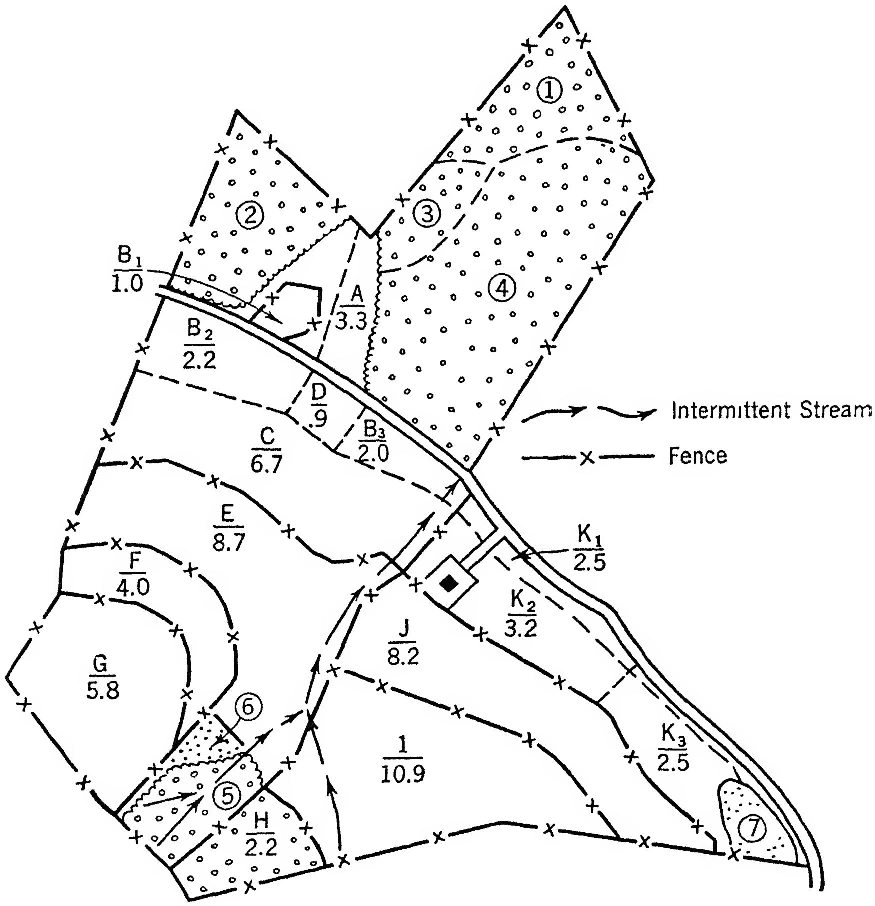

CHART 141. Plan for developing a test-demonstration farm in eastern Tennessee.

fields, all sloping, are to follow a five-year rotation of corn, oats, and clover-lespedeza for three years. The livestock program calls for fuller and better use of the fertilizer and better use of this additional forage and pasture feed.

As for the timber program, two small tracts of gullied land, 6 and 7, are to be planted to black locusts to produce fence posts. Stands 5, 6, and 7 will need to be fenced off. A weeding is needed in Stand 2 to

release the yellow poplar and maple. Stands 3, 4, and 5 need salvage cuttings of old misshapen southern red, scarlet, and chestnut oaks and of sourwood and hickory, to give a chance for the yellow poplar, white, northern red and black oaks, and shortleaf pine to develop. If these cuttings are carried out at the rate of 2 to 3 acres a year, over 15 years, at an expenditure of 25 days of labor per year, they will provide fuel for the family and about 13 M B F of saw timber. Thereafter, the stands will want working over every five years to remove poor and mature trees. Chute has figured out the cut by 10-year periods. Not until the fifth decade will the surplus over farm needs reach $50 a year. The surplus of $75 for the woodland when fully developed will be reached soon thereafter. The alternatives which were budgeted included a continuation of the past program, clearing 3 acres for pasture, and omitting the locust plantings. The second of these will net almost as much income as the one chosen.

More often the farm woodland planning on the test-demonstration farm has taken the form of marking trees to be cut, or designating small areas to be planted, or tracts to be fenced off. Thus on a farm in western North Carolina, the subdistrict T V A forester outlined a program of selective cutting for two tracts, one of 8 acres and one of 35 acres, neither of which had been cut over for many years. The farmer had been induced previously to restrict his cutting of timber for farm use to the scrubby inferior trees. A total of 37 M B F was marked for immediate cutting. The stand remaining was expected to yield a harvest of 75 M B F in 15 or 20 years.

FOREST FARMS The farms thus far considered derive most of their income from their crop and livestock operations. Most of the farm and forest combinations in this country are of this description. The 23,300 forest-product farms reported in the 1940 census, however, obtained the major part of their income in 1939 from timber sales;[7] farms of this description have a definite place in the economy of areas in which most of the land is too rough or stony for cropping, but occasional small fields will grow feed for dairy cows or sheep — in areas like parts of the southern Appalachians and Ozarks, the hill lands of the Northeast, and the cutover regions of the Lake states. When Congress passed the Norris-Doxey Act in 1938 appropriating small sums to be used on extension work in farm forestry, two types of projects were organized, one concerning itself with farms of the sort described in the preceding sections,

[7] Such farms tend to have unusually large sales in particular years, but to average less over a decade.

MARKETING ASSISTANCE The woodland plans developed by the Forest Service on Norris-Doxey projects, however, are mainly cutting programs. The farmers participating from the beginning have been those with a timber crop ready to harvest. The foresters who have been made available under this program have marked the trees to be cut, and have helped the farmers obtain bids and draw up the specifications of contracts that insured saving the younger trees for later harvests. The farmers have usually received more for their timber sold in this way than if they had sold the stumpage and allowed the loggers to strip the woodland. This is a highly useful service. During the war, it was expanded to 220 of the 2,000 timberland counties in this country. The Forest Service spent $47,000 on this service in 1943. The timber products resulting sold for $745,000, which is estimated to be $185,000 more than the timber would have sold for if the farmers had sold it without this help. An appropriation of $5,000,000 would extend this service to all the remaining counties. The farmers learn many of the principles of forest management from participating in this program, and acquire a much stronger interest in their woodlands.

This program would be more helpful, however, if it were expanded to include farms with woodland not at the harvesting stage, and complete plans for woodland development, and for the crop and livestock operations to go with this, as outlined above.

AREA ANALYSIS AND PLANNING

Management of woodlands on farming areas needs also to be viewed from the standpoint of the fitting of all the land in the area into its best uses. A plan for such an area needs to mark off the timbered tracts of various sizes, and decide, on the basis of inventories and analysis, how each can be managed to best advantage. An area in Worcester County that may serve as an example has one block of 6,250 acres of rough, stony land entirely covered with a poor hardwood stand following after cordwood cutting; one in the opposite corner with 2,100 acres of mostly good sapling growth following removal of old-field pine; and two smaller tracts with mixed stands mostly in the 20- to 30-year age class. The rest of the timberland in the town is in farms, but some of these farms do not have enough tillable land to make even minimum adequate incomes possible. The plan which has been spelled out on paper for this area calls for improving most of the stands on these farms, and also consolidating some of the farms so as to make them into either dairy-woodlot units of sufficient size to yield a reasonable income, or into forest-farm units of adequate size. One of the two smaller blocks

of timber is to be absorbed into the adjoining dairy farms. The other is to be partly absorbed in this way and partly made into two forest-farm units. The 2,100-acre tract is all to be converted into forest farms and attached to the small farms with insufficient income now bordering it. The large tract is now owned by eight different persons. The idealized proposal favored by the local planners is to find some family of sufficient wealth and willingness to engage in a long-range speculative investment, and have it buy out the eight owners and then proceed to develop the tract into a largely hardwood forest by restocking some of it, but in the main by letting the trees now starting from stump sprouts grow until they are 75 years old, after which they will no longer sprout vigorously when cut. Some cutting would be done on sites where a fair stand of good sapling hardwoods is coming along.

GREENE COUNTY, GEORGIA A more comprehensive area analysis has been made of the farm woodland management problems of Greene County also in the Georgia Piedmont.[10] When this area was hit by the boll weevil after the First World War, a third of the farms disappeared, and Greene County lost a fourth of its population. The landowners sold their fairly good stands of timber for $1 to $4 per thousand and the old cotton fields grew up to pines. In the 1930 depression, still more old cotton fields reverted to timber. Timber reseeds itself readily in this area, except on eroded slopes, and grows rapidly.

The conservation plans of 230 S C S district farm plans were studied and 1,700 acres of land on 27 farms were analyzed carefully. The stands were put into 3 main condition classes and 18 subclasses ranging from "Highly desirable, 1-a Pine," to "Least desirable, 10, pine hardwoods," with subclasses for bottom hardwoods, upland hardwoods, and the like. Age, composition, number of trees, and growth rates were the bases for these classifications, as well as present management practice, especially fire damage and grazing. Table 107 shows the type of analysis made for each condition class. The second and third columns indicate the stands of timber per acre at each period; the fifth column, the condition class of the timber at that time; and the next three columns, the amount to be cut and its sales value. The stand analyzed in Table 107 includes 250 desirable trees with an estimated 1,500 cubic feet of volume, and 250 undesirable trees with 450 cubic feet of volume.

The results of the inventorying of the woodlands on these farms are presented in Table 108. The small gray-land farms averaged net cash incomes of $136 before the war; the medium-size farms, $265; and the

[10] E. V. Brender and Charles R. Sayre, *Farm Woodlands in Greene County, Georgia*, unpublished manuscript.

large farms, not included in Table 108, only $483. The red-land farm incomes were even a little smaller.

TABLE 107. PER-ACRE INPUTS, ESTIMATES OF PRODUCTION WITH RECOMMENDED TREATMENT, VALUE, AND LABOR FOR THE USUAL CONDITION CLASS 6, BOTTOM-HARDWOODS, GREENE COUNTY, GEORGIA

Year	*Wood volume*		*Treatment needed*	*Condition class*	*Allowable cut*		*Log value at mill*	*Labor*
	Lmbr. *bd. ft.*	*Crdwd.* *cords*			*bd. ft.*	*cords*		*Man days*
Present	2,600	18	Culling	*6*	0	5	0	6
10 years hence	4,200	26	Thinning	*6*	0	4	0	4
20 years hence	12,500	19	Thinning	*1 c*	0	2	0	2
30 years hence	17,000	18	Selective logging	*1 c*	5,000	8	$45	12

TABLE 108. WOODLAND CONDITIONS BY SIZE OF FARM IN GRAY-LAND AND RED-LAND SECTIONS, GREENE COUNTY, GEORGIA

Condition classes by groups	*Class No.*	*Gray land*		*Red land*	
		Small farms	*Medium farms*	*Small farms*	*Large farms*
		Per cent	*Per cent*	*Per cent*	*Per cent*
Highly desirable:					
Pine	*1 a & b*	9.0	14.2	0	5.1
Bottom hardwoods	*1 c*	0	0	0	1.3
Pine	*2*	2.3	5.1	4.4	13.3
Total		(11.3)	(19.3)	(4.4)	(19.7)
Desirable:					
Pine	*3 a*	4.9	2.4	.9	3.9
Pine hardwoods	*3 b*	31.6	19.4	14.0	16.7
Pine	*3 c*	6.0	2.0	8.3	9.4
Pine	*4 a*	4.9	10.0	3.5	2.1
Pine hardwoods	*4 b*	6.0	0	6.4	.5
Pine	*5*	1.1	3.6	12.5	4.9
Bottom hardwoods	*6*	0	0	0	3.7
Upland hardwoods	*6*	4.1	.5	10.8	1.9
Total		(58.6)	(37.9)	(56.4)	(43.1)
Least desirable:					
Bottom hardwoods	*7 a*	0	4.4	0	0
Upland hardwoods	*7 a*	.8	4.0	0	2.5
Bottom hardwoods	*7 b*	1.5	2.6	0	18.5
Upland hardwoods	*7 b*	6.0	7.6	12.5	3.2
Pine hardwoods	*8*	.7	5.5	5.9	2.0
Pine	*9*	4.5	.7	0	.5
Pine hardwoods	*10*	16.6	18.0	20.8	10.5
Total		(30.1)	(42.8)	(39.2)	(37.2)
Total		100	100	100	100

As a final step, a table such as Table 109 was worked out for each farm if present woodland practices were continued, and another if improved woodland practices were followed, and from these was derived a comparison of growing stands, allowable cuts and sales, and residual materials, saw log and cordwood separately. These comparisons for a medium-size gray-land farm taken as an example run as in Table 109. The cordwood in this analysis is timber used for fuel wood and for fence posts. It will be sufficient for the farms under either set of practices. *The most important single change in timber practices called for on these farms is to use cull materials on the farms for use on the farm so as to let the merchantable trees grow into saw logs.* The farms now cut their best trees for fuel wood and posts. The actual cut by 1970 will be worth only $100 more with the improved practices, but the residual crop will be worth $1600 more.

TABLE 109. COMPARISON OF RESULTS FOLLOWING PRESENT AND IMPROVED WOODLAND PRACTICES ON A MEDIUM-SIZE GRAY-LAND FARM IN GREENE COUNTY, GEORGIA

	Present practices	*Improved practices*
1940		
Growing stock	36,300	36,300
Value saw-log cut	0	$80
Volume of cordwood — cords	250	175
Value residual saw-logs	$528	$450
1950		
Growing stock	57,550	64,650
Value saw-log cut	$405	$270
Volume of cordwood — cords	250	295
Value residual saw-logs	$600	$990
1960		
Growing stock	49,250	81,250
Value saw-log cut	$495	$425
Volume of cordwood — cords	250	230
Value residual saw-logs	$490	$1,290
1970		
Growing stock	42,850	106,550
Value saw-log cut	$270	$625
Volume of cordwood — cords	250	170
Value residual saw-logs	$465	$2,060
Total		
Value saw-log cut	$1,160	$1,390
Volume of cordwood — cords	1,000	870

EASTERN KENTUCKY HIGHLANDS A highly interesting analysis has been made of a farm and woodland area in Breathitt County in the eastern Kentucky Highlands.[11] The results of this analysis are pertinent not only for all of the eastern Kentucky Highlands, but for much of the southern Appalachian Highlands. Eastern Kentucky was mostly settled in 1800–1825, and by 1880 had developed a self-contained farming economy almost completely isolated from the rest of the world. Then came a period of forty years of intensive logging which brought employment and increased earnings for a rapidly growing population. When the sawmills closed down, the workers were forced to migrate in large numbers. From 1800 to 1920, the population of Breathitt County increased a fifth or more each ten years. In 1920–1930, it gained scarcely any. In the depressed decade of the thirties, it gained a fifth again.

Four fifths of the land in the particular area studied, the Quicksand area, was in small farms averaging 93 acres, of which 31 per cent was in cropland or pasture land and the rest in timber. The 31 per cent was divided as follows:

Garden and truck crops	0.6	3.0 acres bottom land
Hay	1.0	
Corn	0.7	
Tobacco or sorghum	0.2	
Pasture or idle	0.5	
Corn	5.0	22.0 acres hill and cove land
Truck or other crops	0.3	
Pasture or idle	16.7	

The pasture land is really idle land — it is land which has been cropped till it will no longer produce, and is mostly in process of going back to timber. The bottom land is highly productive and cropped every year. The cove lands are narrow erosion valleys reaching into the hills, and are fairly productive. But three fourths of the cropland is on steep slopes averaging *50 per cent or more* — mostly on the moister and cooler northern and eastern slopes. The cash income of the average farm in 1940 consisted of $100 of receipts from the sale of livestock and livestock products (mostly from the sale of a calf or two that had run on pasture over summer), $10 from forest products, and $235 from off-the-farm earnings and gratuities. The farming is mostly with hand tools. Half the farmers have

[11] This is one of a series of five studies of the Eastern Kentucky Highlands made under the general leadership of William A. Duerr, then of the Appalachian Forest Experiment Station, now of the Southern Forest Experiment Station, and the economics staff of the Kentucky Agricultural Experiment Station. Those participating with Duerr in the Quicksand area study were John H. Bondurant, W. D. Nicholls, Howard W. Beers, R. O. Gustafson, and John B. Roberts.

a mule. The whole family is extremely busy at corn planting time. An acre of hillside corn uses 115 man-hours of work, and averages 15 bushels of corn. The family needs 115 to 135 bushels of corn for food and feed. Duerr and his associates considered four alternative economies for this area as follows:

A. *An intensive subsistence economy* such as will develop if out-migration is checked. The number of families in the area in 1980 on this assumption would be 43 per cent larger than in 1940. The average family on this basis would have 62 acres of land, of which only 2.7 acres would be bottom land. Budget analysis of the operation of the average farm showed that the largest incomes under these conditions would be derived if all but the exposed southern slopes were cleared and only 17 per cent of the land was left in forest. The cove lands would be kept in a rotation with 1 year in 10 in cultivated crops, the gentle slopes, 1 year in 4 to 6; the very steep sheltered slopes, 1 in 15; and the very steep exposed slopes, 1 in 20. The soil mantle would become slowly thinner under this management, but would last longer than under present use. Only 8 acres would be in crops each year. The cash incomes from the farming operations would be raised only from $100 to $125, and the net cash income from $16 to $22. There would be no sales of timber products. The families would need much off-the-farm employment or subsidies of one form or another.

B. *A modified subsistence economy* — 414 families and 90 acres per farm and only 45 per cent of the land in cropping systems of the above type. To test out this program, budget analyses were made of 89 farms. Only 1 in 5 of the farms located on the larger streams, with more bottom land, would need to clear more land to fit into this economy; but 3 in 5 on the narrow streams would need to do so. The acreage in crops each year would be around 9 acres. The cash income per farm would be raised to $170 but the net cash income would be changed very little. The income from timber sale would be $29 per family with no change in timber management from the present.

C. *A modified exchange economy* — 338 families and 109 acres per farm, with 93 per cent of the land in forest. Only the bottom lands and gentle slopes would be cropped — 8 acres per farm. The timberland is assumed to be well managed under this economy, and timber sales would in time reach nearly $200 per year. Still these farmers would be mainly part-time farmers. The operators would work off the farm an average of 105 days per year in woodworking industries and the like. Cash income from farm and woodland would average $237; and

net cash income $96. The off-the-farm income would average $450, minimum factory levels of wages being assumed.

D. Full exchange economy — 173 families, 211 acres per farm, with 96 per cent of the land in woodland; and good timber management. The cash income from timber sales and earnings in woodworking industries would average $1,160 per family. The average time spent annually on timber work on the farms would be 1,840 hours per family, or 1,310 hours per worker. These farms would therefore not be full-sized forest farms such as described above. But in combination with work in local mills, they would provide full employment. This arrangement may very well provide steadier employment over the year than larger-sized forest farms and less factory employment. The shortage of good cropland may make this type of organization best in eastern Kentucky but not in many parts of New England. But marketing furnishes a special reason for it in these highlands. Many of the farms are far removed from railroads or good trucking roads. Many are reached only by wagons over the flat shelving beds of the numerous small streams. The economical organization consists of small processing plants located on trucking roads scattered among the hills. With the timber in its present condition, not enough of it is available to support these plants. But after 25 years of good timber management, this situation would change. This aspect of the problem is discussed in a second study.[12]

WEST VIRGINIA Weitzell and Miller have explored the feasibility of tree farms in somewhat similar territory in the Hoddam Creek area in Webster County in the Allegheny Plateau of central[13] West Virginia and have concluded that this small valley would support thirteen such farms each with 200 acres of timber and a few acres of bottom land, with an income from timber sales, after taxes and insurance, of $835, plus the direct living obtained from the farm. The timber would require 225 days of work per year, not including caring for fire lines and trails. This income would not be available, however, until after ten years or more of woodland improvement work that would return only $235 per year. These families would therefore need to be partly financed in these years.

Most of the land in Webster and Nicholas counties is owned by coal

[12] William A. Duerr, John H. Bondurant, W. D. Nicholls, Howard W. Beers, R. O. Gustafson, and John B. Roberts, *Farm and Forest Resources in the Economy of the Eastern Kentucky Highlands*, Kentucky Agricultural Experiment Station, July, 1945.

[13] E. C. Weitzell and L. F. Miller, *Forest-Land Utilization in Nicholas and Webster Counties, West Virginia*, West Virginia Bull. 309, 1943.

or lumber companies. The families obtain most of their sustenance from employment by these industries or from public relief work. The lumber companies have no interest in developing the stands, and the land is tending to become tax delinquent. A public policy with respect to this land will need to be developed.

WASHINGTON PARISH, LOUISIANA [14] This parish (county) is in the northeast corner of the part of Louisiana that is east of the Mississippi. It typifies the Mississippi-Louisiana Coastal Plain. The original forest was dominantly long-leaf pine, but loblolly pine has become dominant as a result of the severe cutting practiced in the past few decades. The farms average 66 acres, of which half is in some kind of timber, 6 in cotton, and 14 in corn. They average 2.4 milk cows, 6 head of all cattle, and 5 swine of all ages. The hogs range in the woods. The agriculture has become somewhat more diversified in the last few decades as elsewhere on the Southern Coastal Plain.

The woodlands have been overcut, overgrazed and burned over. Less than 10 cords of fuel wood have been cut annually and 120 board feet of lumber per farm, nearly all used on the farms. Of the 180 trees per acre, nearly half are under 4 inches, and 85 per cent are under 8 inches. Half of the trees are oak, gum, or other hardwoods. W. E. Bond's proposed management program of improvement cutting to release pine, of limited grazing, fire protection, and selling saw logs, pulpwood, and trees instead of stumpage, would in 25 years on the usual farm woodland produce a stand of 3 M B F per acre, allowing annual cuttings of around 100 B. F. In 50 years, if one may judge from growth in the older stands, the stands would be 5 M B F and the annual cut would be 160 B F, and in 70 years, 180 B F. The annual crop of salable timber in 25 years would be worth $32 on a 25-acre woodland, and around twice this in 50 years. This would be in addition to fuel and fence posts for the farm.

ARKANSAS Bond also assisted in a similar study, with similar conclusions, for Hempstead County, Arkansas.[15] More distinctive are the results of a survey in the Arkansas Ozarks which brought out the fact that the farmers there believe that forest land yields the most income if the trees are killed and the land is grazed.[16] The usual clearing method is to

[14] K. L. Bachman and R. J. Saville, *Farm Adjustment Opportunities in Washington Parish, Louisiana*, B A E and Louisiana Experiment Station, F. M. 34, 1942. The analysis of the woodlands on the 66 farms studied was made by W. E. Bond of the Southern Forest Experiment Station of New Orleans.

[15] Trimble R. Hedges and M. W. Slusher, *Adjustments in Farm Organization for Increasing Farm Income in Hempstead County*, Arkansas Bull. 442, 1943.

[16] W. T. Wilson and J. W. Reid, *Livestock and Forestry Enterprises on Farms in the Ozark Region*, Arkansas Bull. 419, 1942.

deaden the larger trees, cut the middle-size ones, and slash the rest, and then let goats dispose of the sprouts. Lespedeza, orchard grass, and hop clover are seeded in for pasture. Opinion was about equally divided among the farmers as to whether burning improved or injured woodland pasture. Some thought it hurt the grass, but helped get rid of the brush. Two thirds of the farmers sell a little timber, but no improvement practices of any kind are followed.

SUPPLEMENTARY PRODUCTS

In the lower reaches of the Eastern Cotton Belt, incomes from cotton or tobacco may be supplemented by receipts from the sale of gum naval stores obtained from long-leaf and slash pine. The center of this industry is at present in southeastern Georgia and northeastern Florida. Much of the gum is produced on specialized plantations on land not suitable for crops. But in the Upper Coastal Plain, many farmers work 300 to 3,000 "faces" as a supplementary enterprise. A thousand faces will yield 20 barrels of gum selling for $165 to $200. If the faces are properly worked, the value of the trees for lumber is not depreciated greatly. The equipment needs are small — gutters, cups, buckets, etc. The labor conflicts with corn and feed crops more than with the cotton and tobacco, but the turpentine faces may need to be chipped at the same time as the cotton needs chopping, in which case the gum crop stands aside because the cotton is looked upon as the main money crop.

The labor on the naval stores plantations is mostly special labor that never works in the cotton fields. A typical small plantation in Clinch County, Georgia, owns 10,180 faces, leases 715 more, had a gross income of $3,105 in 1942, expenses of $1,859, mostly the labor of 3.6 workmen (two families), and a net cash income of $1,248, plus products for home use, and a little income from a small acreage of cotton, corn, and peanuts.

Maple syrup and sugar are supplementary sources of income on dairy farms in northern New England, New York, and to a lesser extent in a few other scattered areas. Many of these farms need the income from their maple trees as well as from their small dairy herds. It is no larger than $200 to $300 on a large fraction of the dairy-maple farms in northern Vermont, but this may make the difference between bare subsistence for the family and living with a fair degree of comfort; or between keeping up tax and interest payments or not in periods like the 1930's. The work is mostly done in the very early spring before other field work begins. Much of it, however, is wet and cold work, and as farmers advance in years, they may decide to forego the additional income. This alone does

little or no harm to the maple groves. But sometimes the older farmers, needing income to support them in their last years, sell their maple trees for lumber. Without the maple grove, however, the farm may no longer be salable and may be abandoned. The farms with larger groves are able to introduce laborsaving methods and may get a sizable fraction of their income from this source.

Farm woodlands are usually too small to yield any commercial income from wild-life management, but providing a few narrow borders on the edges of wood lots will increase somewhat the game population of the neighborhood. Many farm woodlands have small bodies of water that could be stocked with fish to good advantage. Fish ponds need to be fertilized with ordinary commercial fertilizer several times during a season so as to keep up the supplies of the microscopic green plants upon which the small species feed, which in turn become food for the larger species. Properly managed, southern fish ponds will support 500 to 600 pounds of fish per acre, half of which can be fished out to advantage each year. A good combination is bluegill bream and large-mouth black bass, perhaps with crappie in addition. Simple methods have been developed for keeping ponds clear of weeds.[17]

PUBLIC MANAGEMENT OF FARM WOODLANDS[18]

The public at large and the nation have an interest in keeping sloping lands under a good timber covering that far transcends the interest of the farm woodland owner. A woodland with a mantle of dead and decayed leaves catches and holds about all the water that falls and the water from melting snows, and adds this to the groundwater supply that feeds the streams that supply the irrigation water and well water used at lower levels. Such water is also fed to streams slowly and as clear water free from sediment. This prevents floods and also the filling up of stream beds and reservoirs with silt. Even in the matter of the timber supply, the nation has an interest reaching much more strongly into the future than that of most private individuals.

The most direct method of protecting this national interest is for governments to take timberland into public ownership and management. No other method would have sufficed for most of the timberland now in public ownership; and additional land is constantly falling into this class because private individuals are no longer willing to carry the minimum responsibilities of ownership. For most of the land in farm wood-

[17] H. S. Swingle and E. V. Smith, *Management of Farm Fish Ponds*, Alabama Bull. 254, 1942.

[18] John D. Black, "The Role of Federal, State, and Local Governments in Promoting Forestry," *Proceedings of the American Philosophical Society*, Vol. 89, No. 2, 1945.

lands, however, a program of public participation in management such as described in Chapter XXXVI will suffice. The phases of such a program, in order of priority, are as follows:

A. Aid in the prevention of forest fires, in collaboration with woodland owners. This includes education in the need for such control and in methods of control.
B. Similar aid in the control of diseases and pests.
C. Research on all phases of woodland management, including marketing.
D. School and adult education in all phases of forestry. Extension work in this field is very inadequately developed.
E. Aid in farm woodland planning such as outlined in this chapter.
F. Similar aid in the marketing of timber products.
G. Credit to woodland owners to enable them to develop their woodlands to the stage where they will yield a current income. This type of credit has scarcely been used at all in this country. Governments can afford to subsidize such credit by making it available at low rates of interest, as an alternative to public ownership.
H. Credit to assist in the development of marketing facilities and needed processing plants.

In many situations, the foregoing types of aids can be extended to advantage through cooperative organizations of woodland owners. Relatively few of these are now operating, and methods are not well understood as yet, but enough progress has been made so that, with the guidance which the Forest Service and state agencies can now furnish, many communities can embark on such ventures with relative safety.

FURTHER READING

John D. Black, "Notes on 'Poor Land,' and 'Submarginal Land'," *Journal of Farm Economics*, May, 1945.

*A. C. Cline, *Improvement Cuttings and Thinning as Applied to Central New England Hardwoods*, Massachusetts Forest and Park Association Bull. 155, 1935.

*J. A. Cope, *Growing Wood as a Crop on New York Farms, Part 1. Trees and Products*, Cornell Bull. 270, 1933. Also Bull. 291.

*Daniel Den Uyl and Ralph K. Day, *Woodland Livestock Carrying Capacities and Grazing Injury Studies*, Purdue Bull. 391, 1939.

*E. E. Isaac, *Shelter Belts for Montana*, Montana Bull. 194, 1941.

*F. T. Murphey, *Farm Woodlot Timber*, Pennsylvania Circular 149, 1934.

*H. S. Telford and C. A. Stevens, *Uses and Management of Ponds and Lakes*, North Dakota Bull. 313, 1942.

*George W. C. Turner, *Harvesting Timber on the Vermont Farm*, Vermont Circular 94, 1937.

CHAPTER XLVII

Part-Time and Self-Sufficing Farming

THIS FINAL CHAPTER IN PART FIVE IS RESERVED FOR THE VARIOUS TYPES and descriptions of *incomplete* farms to which are applied such names as part-time farms, self-sufficing farms, noncommercial farms, subsistence farms, residential farms, peasant farms, abnormal farms, and the like. They are reserved for the last because so far as their purely farming operations go, no principles are introduced that have not already been discussed. They are either farms which produce solely or largely for home use, which were discussed in Chapter XV, or combinations of such farms with vegetable farming, fruit farming, poultry farming, dairy farming, tobacco farming, or farm wood-lot farming.

Differentiating between the forms of incomplete farming is not simple. In the 1930 census, any farm in which the head of the household worked outside his farm for 150 days or more was called part-time, provided the value of products did not exceed $750, and any farm not a part-time farm under this definition whose output was more than half consumed by the farm family was called self-sufficing. A large majority of the part-time farms, however, produce solely or almost solely for home use, and a self-sufficing farm may have up to 50 per cent of commercial output. The self-sufficing farms in this classification therefore have more commercial production than the part-time farms. These two types of farms therefore merge into each other, and in practice it may be impossible to separate them except on some arbitrary basis.

If it is necessary for statistical purposes to put these farms into definite classes, the scheme adopted in 1935 by I. G. Davis and L. A. Salter of the University of Connecticut can be used. They put all farms with less than 50 productive man-work units (days of labor) into a class called *residential;* those with 50 to 150 into a class called part-time farms, and all the others into the regular commercial-farm class.[1] The residential farmers, however, may have no other occupation.

[1] I. G. Davis and L. A. Salter, Jr., *Part-Time Farming in Connecticut, a Preliminary Survey,* Connecticut Bull. 201, 1935.

If the part-time farming concept is applied vigorously, however, many farms with more than 150 man-days of work done off the farm are part-time; likewise, farms with values of product of more than $750. It is entirely possible for the head of the family to have a job that employs him more than half the time and for him and his family to contribute much more than 150 days of labor. Even though he may hire some labor, his farm is still a part-time farming enterprise. There are numerous situations around industrial centers, particularly the smaller ones, in which the sons and daughters get jobs at near-by plants but continue to live at home and contribute a share of their earnings to the family. Before the surrounding farms became so mechanized, the sons often found farm employment. The automobile, plus less farm work, and the strong ties which keep many living at home, add greatly to the elasticity of the rural labor supply in normal times.

Thus when Boonstra and Jackson analyzed the farming operations of the 64 workers in a paper mill at Bogalusa, Louisiana, who were living on farms, they put them into the classes shown in Table 110.[2] On 16 of these farms, an average of 252 man-days of labor was performed. This group averaged 6 acres of cotton and 14 acres of corn, 6 head of dairy stock, and 7 swine.

TABLE 110. CLASSIFICATION OF 64 PART-TIME FARMS IN THE BOGALUSA AREA OF LOUISIANA, 1939

Type of part-time farm	*Number in group*	*Average acres in crops*	*Average productive-man-work units*	*Average cash receipts*
Residential	28	2.4	41	$10
Semicommercial	20	10.4	92	81
Commercial	16	25.0	252	639
All part-time farms	64	10.5	116	190

Difficulty also arises over another type of situation, that in which the family has an income from investments, pensions, and the like, and lives on a farm either because it prefers country living or because it needs to supplement this outside income or make it go further. These are part-time farms in the sense that the family does farm work only part of the time, but not in the sense of their working part of the time

[2] C. A. Boonstra and Hilliard Jackson, *Part-Time Farming in a Rural-Industrial Area of Louisiana*, Louisiana Bull. 333, 1941.

at other work. The 1930 census classified these as either self-sufficing or regular commercial farms.

In the rural areas bordering on cities, one will find all types of the foregoing and all gradations between them. Thus in two such rural townships in Rhode Island, Gordon and Meldrum found that 37 per cent of the rural households in 1940 did not have even a garden, 27 per cent were "backyard producers" (less than 10 days of work), 16 per cent were "small-scale" producers (11 to 50 days of work), and only 9 per cent were real part-time farmers according to the Davis-Salter classification, and 12 per cent were commercial farms.[3]

PART-TIME FARMING

The 1930 census classified 339,200 farms as part-time. The 1935 census, however, reported 572,000 farm operators as working off the farm 150 days or more in 1934. The 1940 census, it will be recalled, has no classification for part-time farms, and reports 944,000 as working off their farms 100 days or more. The comparable figures on this latter basis for 1934 and 1929 are 761,000 and 723,000 respectively. The farm operators reporting off-farm work averaged 137 days of it in 1939, and only 100 in 1929. Half, at least, of the increase is because the 1929 census count of part-time farms was too low.

The heaviest concentrations of the farms with 100 days or more work off the farm in 1940 were in the southern Appalachians from West Virginia to the southern Tennessee border and in western Pennsylvania and eastern Ohio. Smaller clusters occur around all the larger cities, but especially those in southern Michigan, in Ohio and Indiana, and in Washington-Oregon. In the Northeast, part-time farming seems to be fairly evenly spread, with some intensification in eastern Massachusetts, western New York, and from Philadelphia south to Richmond.

Perhaps as much as a fourth of the off-farm work is upon other farms.[4] Of the remainder, from 30 to 37 per cent in the different regions is in industry, from 11 to 16 per cent in trade, from 12 to 14 per cent in construction, from 8 to 11 per cent in the professions and government, the same in transportation, and from 5 to 8 per cent in mining.

MANAGEMENT PROBLEMS The management problems that are special to part-time farming arise mainly from the fact of its combination with

[3] William R. Gordon and Gilbert S. Meldrum, *Land, People, and Farming in a Rurban Zone*, Rhode Island Bull. 285, 1942. Also see H L. Hawley, *Small Agricultural Holdings in Two Industrial Areas in Indiana*, Indiana Bull. 460, 1941.

[4] The 1930 census data do not report the amount of such labor.

other work. The first question to decide is whether one's job is sufficiently secure so that one can afford to take a chance on investing in a part-time farm. It is true that the operations on such farms can usually be stepped up in case one's job comes to an end; but most part-time farms will not take the place of a job. One's fellow workers may be losing their jobs at the same time and the farm may be hard to sell. (Of course, this is a danger that faces any worker when he buys a home.) Investment in part-time farms is always safer around a city that offers diversified employment. It is better to rent than to buy if there is considerable doubt as to future employment in the area.

Renting is also better than buying at the start if the family has had little experience with country living and needs to try it out for a few years to see whether it will suit them.

The next question is how much farming to undertake, whether to produce only garden vegetables and fruits for the family, or milk, eggs, and meat for the family in addition, or to produce also for the market, and if the latter, how sizable a commercial enterprise. Seldom will it pay to reduce the work off the farm so as to produce more on the part-time farm, unless the family is in a position to do this for the pleasure of it. The problem, then, is how much production there will be time for. Part-time farmers frequently overreach themselves. Bell and Scoville estimate that with the work done on the small scale necessary on most part-time farms, a well-diversified family garden of one acre will take 100 hours of labor a month for two months at the peak, and a total of 415 hours for the year; that one milk cow will take 225 hours; 25 to 50 laying hens, 144 hours per year; 3 pigs, 72 hours; and 40 colonies of bees, 225 hours. If corn is grown for feed on such a farm, it will take nearly 50 hours an acre if it is cut and husked by hand.[5]

There seems to be a tendency for part-time farms to be either too large to be handled in addition to a regular job, or too small to provide a full living. This was certainly true of those created by the Resettlement Administration, and its predecessor, the Subsistence Homestead Division in the Department of the Interior. As a result, some of the families rented part of their land to their neighbors.

The location of a part-time farm is highly important. Many workers traveled 15 to 25 miles to and from work in the high unemployment of the 1930's and during the war years, but they tend to find it an unwel-

[5] Earle H. Bell and Orlin J. Scoville, *Part-Time Farming*, U.S.D.A. Farmers' Bull. 1966, 1945. The comparison of 144 hours per year for 25 to 50 hens on the small flocks on part-time farms, with 204 per year per 100 hens on the larger flocks mentioned in Chapter XLIII, is indicative of the inefficient use of labor on part-time farms.

come burden on their income and time in normal periods. A large fraction of the part-time farmers have relatively low incomes. Otherwise they would not be trying to stretch their incomes in this way. Keeping an automobile in operation so as to be able to live on a part-time farm is seldom warranted. If the family runs an automobile anyway, only the cost of the extra travel is involved. Some of the studies of part-time farming report transportation costs as high as $125 a year.

Other factors in location are water supply, fire protection, electricity, schools, roads, and markets. Some of these may cost much more to provide in locations out from cities than within them, or they may be harder to reach — the schools, for example. Location on a main highway may mean high land costs, but much better access. In general, part-time farms tend either to be small, from one to three acres, and close enough together so that they can have the same public utilities as city residences, although at higher costs; or to include considerable poor woodland and to be dispersed over a rather wide area, which puts some of the public utilities out of reach. The real-estate subdivisions designed especially to provide small part-time farms may entail heavy outlays. Certainly some of those developed by the Resettlement Administration cost too much.

The part-time farmers who want to produce for the market need to consider market outlets carefully before choosing a location, or adapt their production to their market. Poultry production is usually well suited to part-time farming for several reasons, one of which is that eggs and chickens can be sold anywhere. The milk from two or three cows can be distributed among the neighbors if they do not have cows. Having too many cows in such an area calls for special marketing arrangements. A small amount of a succession of vegetables is bothersome to market; concentration on one or two may make more work at certain periods than can be spared from the regular job.

Other advantages of poultry production are that it has a fairly even labor load, and requires relatively little land. Cows require pasture land and the hauling of a good deal of forage. Goats are much better suited to part-time farms than are cows, but there may be no market for surplus goat milk as milk.

A major handicap of part-time farms has been the power supply. Growing feed for a horse or mule may take about all the time the family has to spare. A common solution is that a few of the part-time farmers keep a work animal or two and do custom work for the others. The garden tractors available in the past did not have enough power for plowing. The new ones cost so much that only joint use by several farmers brings them within reach of many part-time farmers.

If part-time farming is to be practical on a few acres, they need to be of good quality. The returns from applying much hand labor to land are small enough at the best. Some land ordinarily considered poor, however, has a high capacity for fertilizer and can be made very productive under intensive use.

About the last use of land that one could suggest as meeting the above needs of part-time farming is use in growing timber. But, in fact, around a half of the 47 acres in the average part-time farm in 1930 was in timber of one sort or another. This is because part-time farming is prevalent in areas with much rough land that will grow only trees. A tract of 40 to 80 acres of such land may contain only an acre or two that is suitable for crops, and a few more acres of open pasture. Much of the part-time farming land in the Northeast is land that has been abandoned for any actual farming. Part-time farms in such areas have all the disadvantages of being far apart and more or less isolated. But they persist because the land is cheap, or because the population pressure is acute.

Given the conditions described, timber has many advantages as a part-time farming crop. Much of the work on improvement cutting, weeding, and pruning can be done at any time. The waste wood can be used as fuel. Very simple tools will suffice except for the hauling, and this can be hired.

Credit has not been freely available in the past for the purchase or development of part-time farms. They have not usually been accepted as falling within the definition of farms, since the major portion of the income has been earned elsewhere. The banks have tended to eschew them because of doubting their stability. The Farm Credit Act was amended in 1935 to include loans on a "prudent investment" in part-time farms. But if loans can be made safely to industrial workers to buy homes in factory-worker sections of our cities, certainly they can also be made to industrial workers to buy rural homes. Davis and Salter found that the average part-time farmer in Connecticut in 1934 had occupied his place for 13.6 years.

SAMPLE AREAS Let us now consider briefly a few typical part-time farming areas. The 28 Bogalusa *residential* farmers averaged 41 days of labor on the farm, 2.4 crop areas, 1 cow, 4 hogs, and 24 hens. Their cash receipts were only $10 in addition to the $1,500 earned in the paper mill. The produce supplied by their farms, valued at the farm where produced, was inventoried at $218, and the use of the dwelling at $155. The next group in Table 110, averaging 92 days of labor, had 10 crop acres, 2 milk cows plus young cattle, and 6 hogs, and cash receipts of $81 after supply-

ing the family with food worth $340. Against this $81 + $340 + $184 for use of dwelling, for the second group, were cash outlays for feed, fertilizer, labor, etc., totaling $150, leaving a net return from the farming operations of $455; or $390 after deducting depreciation; or $300 after also deducting a 5 per cent allowance for the use of capital. This is $3.30 per day. If the food had been bought in the city, it would have cost much more than $340.

The usual part-time farmer in the South earns much less than $1,500 at his off-the-farm job. The 1,113 farmers in Alabama, Georgia, and South Carolina surveyed in 1934 by R. H. Allen and associates earned around $700.[6] They averaged 7 acres of cropland. The group included 14 per cent that grew vegetables only; 17 per cent that produced vegetables and poultry; 6 per cent, vegetables and dairy; 14 per cent, all three; 12 per cent, vegetables, poultry, and pork; and 24 per cent, all four. Half of these had at least one milk cow and about half, one or more hogs. Only one in four owned any workstock. Only around 13 per cent of them had any significant cash receipts. The cash receipts for the whole group averaged only $40. Over half of these families were tenants, and a third were Negroes. They were employed mostly in the cotton textile mills, in the coal and iron industries of Alabama, and in the lumber and naval stores industries. Average distance to work was less than three miles.

Kenneth Hood studied 725 part-time farms in New York State in 1932–1933.[7] They averaged $751 from off-the-farm earnings, $136 from farm cash sales, and $301 from food furnished by the farm plus use of the farm dwelling. Deducting cash expense and depreciation left $246 for 48 days of work by the operator, not including that of other members of the household. These farmers, it is apparent, were small-scale part-time farmers. Only 106 of them had even one cow, and half of them had no chickens, and a fourth had no gardens at all, and only one tenth had an acre or more of garden. On the other hand, half of them sold produce averaging $163 per year, through the following channels in order of importance: to neighbors, peddled to city consumers, to dealers or buyers, to stores, at roadside stands, to consumers calling at the farm and at place of employment. The average distance to work was 4.4 miles.

Four groups of Kentucky part-time farmers surveyed in 1934 had farms averaging 12 acres, but half of them had 3 acres or less. They

[6] R. H. Allen and associates, *Part-Time Farming in the Southeast*, Works Progress Administration, Division of Social Research, Research Monograph IX, 1937.

[7] Kenneth Hood, *An Economic Study of Part-Time Farming in the Elmira and Albany Areas of New York, 1932 and 1933*, Cornell Bull. 647, 1936.

averaged 2 hours of work a day on these farms, in return for $77 of cash receipts, plus $335 from food and use of dwelling, less $166 of cash expenses and $34 of depreciation — a net of $212 for 65 days of work.[8] The off-farm earnings averaged $900. Over a fourth of the farms had no chickens or cows, and 40 per cent had no cows. Some of the farmers grew a small acreage of tobacco. Some of this group of part-time farmers were not living in the country to increase their incomes, but because of preference for country life.

A group of 104 Negro part-time farmers near Lexington, Kentucky, studied at about the same time, averaged only $204 of outside income.[9] These were domestic servants, janitors, and unskilled workers on construction, railroad, and general farm work. Many had been forced to adopt part-time farming because of losing their jobs in the Big Depression. Most of their average cash income of $65 was from tobacco. Their farms averaged 3 acres. A fourth of them were tenants. Ten kept no poultry or livestock, and 30 had no cows. The surveyors valued the food obtained from their farms at $68 and the use of their dwellings at $68.

A sample of 1,508 part-time Indiana farms, drawn from eleven counties, surveyed by Smith and Lloyd in 1933, averaged 13 acres of land and 4 acres in crops.[10] All but 14 had gardens, but an eighth had no poultry and a third no cows and an equal number no hogs. The cash receipts averaging $60 were nearly all from livestock. The surveyors valued the food consumed at $146, at farm prices, of course, and the use of the buildings at $78. These part-time farmers earned only $500 at their off-farm jobs in 1933. Over half of them were employed in factories, mines, and quarries.

The Washington studies by Pubols in 1933 covered 1,814 farms, mostly in a belt south from Puget Sound.[11] Relatively few of the off-farm jobs were in factories. The largest group was engaged in lumbering, construction, and railroad work. Most of the farms were around 2 acres in size, with from a half acre to an acre in vegetables and fruit. The cash sales, however, averaged $120, the farm produce consumed by the family was valued at $174, and the house rentals at $130, making a total of $424, with the cash expenses of production averaging $130. The off-farm work earned $675. The farming income was therefore an unusually large

[8] Merton Oyler and W. W. Rose, *Part-Time Farming in Four Representative Areas of Kentucky*, Kentucky Bull. 358, 1935.

[9] Merton Oyler, W. W. Rose, and W. D. Nicholls, *Part-Time Farming by Negroes near Lexington, Kentucky*, Kentucky Bull. 365, 1936.

[10] F. V. Smith and O. G. Lloyd, *Part-Time Farming in Indiana*, Indiana Bull. 410, 1936.

[11] Ben H. Pubols, *Part-Time Farming in Washington*, Washington Bull. 316, 1935. This bulletin describes a series of typical part-time farming organizations.

fraction of the total. Two thirds of the production was poultry and dairy. Pubols describes three principal types of farm organizations found in this area: (a) a garden and a few chickens, with production averaging $70, with no sales, and expenses of $20; (b) a cow and large flock of hens, with production averaging $225, and $40 of sales; (c) a farm of around 10 acres, with 3 acres in crops, 2 cows, and less poultry, and sales averaging $130.

Several other stations made surveys of part-time farming at about the same time as the last six. Interest in it became acute in the Big Depression. The off-farm earnings in nearly all areas were lower than normal because of the depression, and so were the values of farm products. The farms contributed much more to family living than appears in most of the figures. If the same families were buying these farm products in the city at retail prices, and paying rent in cities, these two items would make a considerably larger portion of the family income than is reported in the studies even after allowing for additional transportation costs.

Clearly the contribution to living which these farms make is their major function. They evidently make the meagre incomes of these families go significantly further toward providing them adequate living. A majority of the farms surveyed were of the "residential" type, with either only a garden, or a garden and poultry, or possibly a cow. As the farms become larger, the first effect is to increase the food provided the family. Only a fourth to a third of the farms in the different areas produce much of anything for the market. Such production, however, can contribute importantly to the income of families that are not fully employed off the farm. The number of such families is increasing rapidly with the shortening of work weeks. The increasing number receiving pensions of one kind or another will also add to this latter group.

SELF-SUFFICING FARMS

According to Table 36 in Chapter XV, the cash sales of the 498,000 self-sufficing farms of the United States in 1929 averaged $140, and the farm products used by the family were worth $280 at farm prices. The self-sufficing farms have both larger cash sales and larger production for family use, than the part-time farms, especially the latter. No data are generally available as to the receipts from off-farm work, but in normal years they averaged from $100 to $300 a year in most of the areas. These farmers therefore depend much more on their farms for their living than do the part-time farmers.

In actual situations, however, it may be difficult to draw the line

between part-time and self-sufficing farming. Thus out of a group of farms surveyed in Knott County, Kentucky, all but 16 per cent had outside incomes in 1929 and all but 21 per cent in 1939.[12] Included in the group were 52 families that earned an average of $880 working in coal mines, and 62 who earned an average of $275 at W P A and other relief work. The outside incomes from other sources averaged $142 to $212 per farm. Between 1929 and 1939, the farm output had declined and the outside work had increased. Part of the reason for this was that the building of highways had brought in outside produce and lessened the demand for local produce.

Of the 50 type-of-farming areas listed in 1930 as including more or less self-sufficing farming, nearly all were located in the Appalachian mountain chain beginning in Pennsylvania and reaching down through the western Carolinas, eastern Kentucky and Tennessee, to northern Georgia, in much the same territory as the major group of part-time farmers. A smaller center is in the Ozarks in the adjacent corners of Arkansas, Oklahoma, and Missouri. The self-sufficing areas of Kentucky and Tennessee spread out westward from the mountains, in southern Kentucky almost to the Mississippi River. Let us examine some of these self-sufficing farming areas in a little more detail.

The most concentrated center of such farming in the United States is in the southern Appalachians. Three type-of-farming areas in this region may be taken as examples, namely, a large area called the Cumberland Highlands, reaching from western West Virginia, across eastern Kentucky and down into east central Tennessee; the Allegheny plateau and mountains to the north of the Cumberland Highlands; and the Great Smoky Mountains in extreme western North Carolina. The Limestone Valleys of Kentucky and Tennessee cut through the middle of these three areas. From 51 to 65 per cent of the farms in these three areas were classified as self-sufficing in 1930, and 58 to 67 per cent of the product of all the farms in these areas was for home consumption. The value of product of the self-sufficing farms in these areas in 1929 averaged around $400, of which around 75 per cent was home consumption. In typical counties in these areas, the farm acreages ran from 57 to 81 acres, of which 15 to 18 per cent was cropland harvested. Most of the rest was classified as woodland pasture. These farms were keeping from 2 to 3 head of cattle. The principal crop was corn, much of it for direct human consumption. Some of them grew a little tobacco as a cash crop. They averaged around 3 head of swine.

[12] R. H. Allen and Charles G. Deaton, *Trends in Land Use and Related Changes in Knott County, Kentucky, 1929–1939*, Kentucky Bull. 428, 1942.

On the borders of these mountain areas are the Piedmont sections. Fewer of the farms in the Piedmont are self-sufficing, but those that are so classified resemble closely those in the three areas. In Meigs County in southeastern Ohio, for example, only 38 per cent of the farms were self-sufficing in 1929, but those thus classified had an average value of product of only \$420 and only 2.5 head of cattle. This same description fits the Piedmont area of Virginia, where 41 per cent of the farms were self-sufficing, with \$450 of value of product and 2.8 head of cattle. The Blue Ridge Mountain areas of Virginia and North Carolina are like the two just described except that more of the farms grow a little tobacco.

The self-sufficing farms in the mountain areas to the north — for example, in the Allegheny plateau of Pennsylvania and the Catskill Highlands of New York — are interspersed among small dairy farms and had from 3 to 5 head of cattle, and values of product in 1929 of \$500 to \$600, of which around 70 per cent was home consumption.

The self-sufficing farms in Central Tennessee are on the eastern and western Highland Rims on either side of the Central Basin, and those of southern Kentucky are in the Cumberland Valley just to the north, and in the western coal-mining section of Kentucky. Only from 32 to 42 per cent of the farms of these areas were self-sufficing in 1929, and from 36 to 41 per cent of the agricultural production of the areas was consumed by the farm families. On the self-sufficing farms themselves, however, the gross value of product ranged only from \$360 to \$460, of which from 51 to 74 per cent was home consumption. These farms had from 1.7 to 2.7 head of cattle per farm. A few of them grew a little tobacco.

South of the Central Basin in Tennessee, cotton comes into the picture and relatively few of the farms are classified as self-sufficing. Those that are, however, have incomes no larger than the self-sufficing farms of northern Tennessee. The difference is that they are intermingled with *cotton* farms rather than with *general* farms. In the piedmont or clay-hills section of Mississippi and Alabama to the south, only about one tenth of the farms were classified as self-sufficing, the rest being small cotton farms mainly. The self-sufficing farms here averaged around 83 acres of land in 1929, only 15 per cent of which was cropland. They had from 3 to 4 head of cattle per farm, and from 3 to 5 head of swine.

In the center of the Ozark Mountain country, over half the farms are self-sufficing. They averaged \$400 worth of product in 1929, and had 91 acres of land, of which 19 per cent was harvested crops. Corn is the principal crop. It is used for direct consumption and to feed 3 to 4 head of cattle and fatten a few hogs for the use of the family. In the part of

the Ozarks called the Ouachita Mountains, located in Arkansas and across the line into Oklahoma, more of the farms were classified as cotton than as self-sufficing, and the self-sufficing farms grew more cotton.

A large area in southeastern Missouri just west of the Delta country also has a good many self-sufficing farms. These averaged around 97 acres in 1929, of which 24 per cent were in harvested crops, corn mostly. In the area stretching across extreme southern Illinois and into extreme southern Indiana, about one fifth of the farms were classified as self-sufficing. The value of product of these farms in 1929 ranged from $450 to $670, of which around 65 per cent was for home consumption.

The self-sufficing farms of this country are thus remarkably uniform. They have relatively small acreages, and three fourths or more of their land is poor woodland or woodland pasture. They keep from 2 to 4 head of cattle and 2 to 3 hogs. Most of the milk and meat is used by the family, but on some farms a partly-grown steer is sold once in a while, or a little butter is sold. Many of them also sell a little of some cash crop.

These self-sufficing farms are small mainly because of the pressure of population on the land. The reproduction rates in these areas are the highest in the country, and migration out is not rapid enough to reduce the number of families. The farms have been getting smaller in most of these counties ever since the Civil War. Knott County, Kentucky, had 2,645 farms in 1940, compared with 1,951 in 1930 and 1,771 in 1910. Acres of land per farm declined from 114 to 55 in the same period.

In similar territory in New England, New York, and much of Pennsylvania, however, many of the mountain farms have been "abandoned," and the land has reverted to timber. The developing factory towns provided jobs for the young people, and the old folks were left stranded on the farms. When they died, no one took over the farms. This process is already operating in many of the remaining self-sufficing areas. It is already strongly under way as far south as the Virginias.

FURTHER READING

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Part Six

FINALE

CHAPTER XLVIII

Agriculture in the National Economy

IN THE CHAPTERS BEFORE THIS ONE, THE POINT OF VIEW HAS BEEN mainly that of the individual farm and farm family trying to maximize its income and well-being by operating its farm as effectively as possible. Attention has frequently been called in these chapters to the circumstance that the adjustments which they as individuals make may combine to increase the supply of some product to the point that prices are lower than justify this much production; or conversely, to decrease the supply until prices warrant a resumption of some of the production. In theory, these shifts in production and price changes oscillate up and down until an equilibrium is reached. In practice, as we noted in Chapter XX, this equilibrium is seldom exactly attained. Technological changes in agriculture, or economic changes in the outside world, keep supplies and prices in such constant flux that rarely do they come into balance at the equilibrium point. Moreover, there seems to be a tendency for farm production to lag in its adjustment downward toward the equilibrium. A full analysis of the problems of agricultural production therefore calls for an approach from the standpoint of agriculture as a whole as well as from the standpoint of the individual farm and family. This phase of the economics of agricultural production, however, mostly lies outside of a textbook in farm management. Only enough of it is included here to give farm management a setting in the general economy.

THE INTERDEPENDENCE OF AGRICULTURE AND THE REST OF THE ECONOMY

First, we need to raise briefly the question as to the extent to which agriculture is dependent on the general economy, and the general economy in turn upon agriculture. Someone in agriculture is always trying to demonstrate that industry and trade cannot flourish unless agriculture is prosperous. Some earlier writers — for example, the English economist Jevons in 1875, and the American economist H. L. Moore

in 1914, believed that they could show that economic activity fluctuated according to the size of crops, and these in turn according to sun spots and solar radiation. Sometimes their arguments have been to the effect that the larger crops give farm people more purchasing power, and

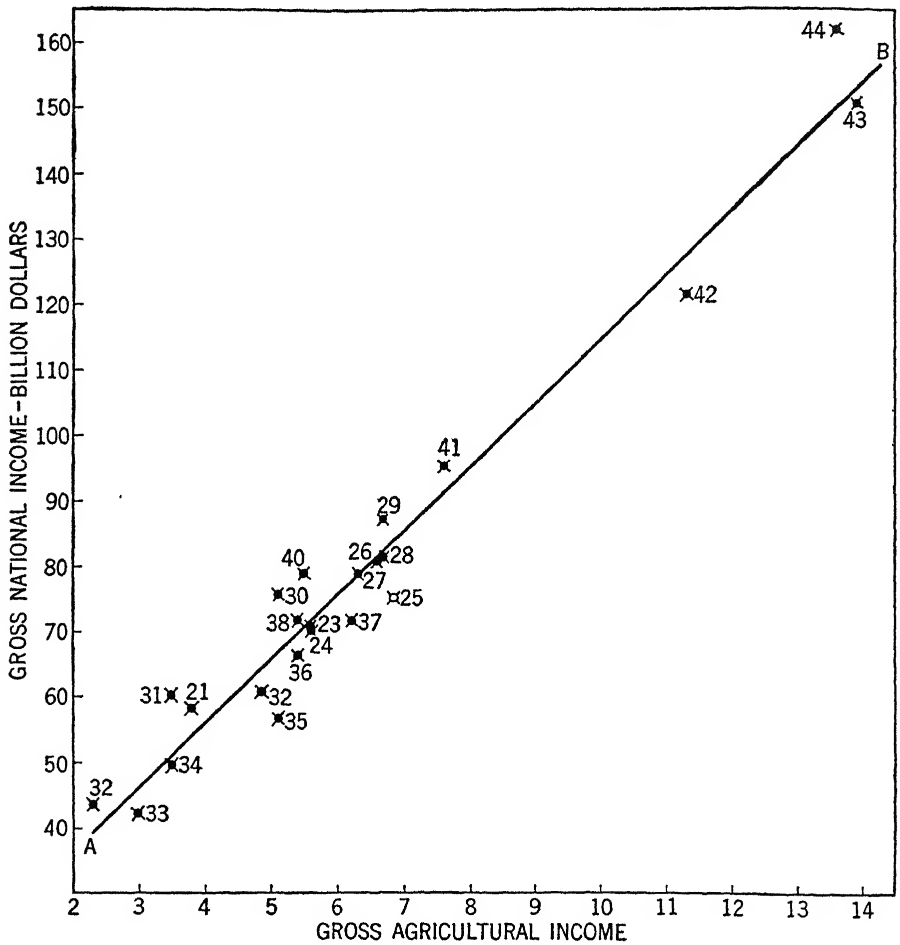

CHART 142. Gross national income and gross agricultural income by years, 1921 to 1945; also line AB of average relationship.

sometimes almost to the contrary, that they make food and fibers cheap and thus give industry and trade a large volume to handle on good margins.

The evidence in support of these propositions is now usually presented in the form of charts showing how agricultural income and national income move up and down together from year to year; or in the form

of Chart 142. If the two were perfectly correlated, all the crosses would lie on the line AB. But still this would not tell us *which caused the other*, or for that matter, *whether either caused the other*. Chart 143 presents in a similar way the correlation between factory pay rolls and national income. The correlation is slightly closer in this chart than in Chart 142.[1] The truth of the matter is that *all these move together in the main because of wars and postwars, and cycles of prosperity and depression, which are caused by a whole complex of factors*. They move together because they have a common cause, just as different plants send out their leaves at about the same time in the spring, and shed them in the fall, because of the changing seasonal angle of the sun's rays and hours of sunshine.

It is reasonable to believe that the prosperity of a largely agricultural country, like Russia before her Revolution, is strongly influenced by the size of her crops; but not that of a country like the United States which now, in terms of income, is only one tenth agricultural. The sales and earnings of manufacturers who sell largely to farmers are, of course, affected strongly by farm incomes; and likewise the prosperity of any city which serves agricultural regions largely. But the big cities of the East are affected only a little by what happens to the agriculture of the country.

The chain of relationships by which a war or postwar, or a swing from general business expansion to recession, affects agricultural income is clear enough. As employment expands, and nonfarm earnings increase, the demand for farm products grows faster than they are supplied, and prices rise sharply, as they did in 1941–1942, and briefly in 1936–1937. Some prices of farm products rise faster than others, either because their demand picks up more rapidly with expanding industry, or their supply responds more slowly, or because their demand and supply are more nearly inelastic. Rising wages usually play a very minor role in the growing demand for farm products — fuller employment of men and plants and equipment is the major factor. In recessions, of course, the reverse of this sequence of changes sets in.

It follows from the foregoing that agricultural prosperity in the United States is closely dependent upon a high level of urban employment. An increase in wages which reduces the total pay rolls of nonfarm workers by reducing employment too much has an adverse effect on agriculture. There may have been such increases in the 1930's. Agriculture, moreover, benefits most from an increase in the earnings of the lower-income urban groups, because these groups increase their demand for food most.

[1] The correlation in Chart 142 is + .956; in Chart 143, + .965.

But more important for agriculture, except in the very short run, than the effects of high-level employment on the demand for food and textiles are its effects on the migration of young farm people to the cities. In the years before the war, 350,000 farm workers needed to leave the farms each year if the farm population was not to expand. The increasing use of power and machinery was actually releasing many more than

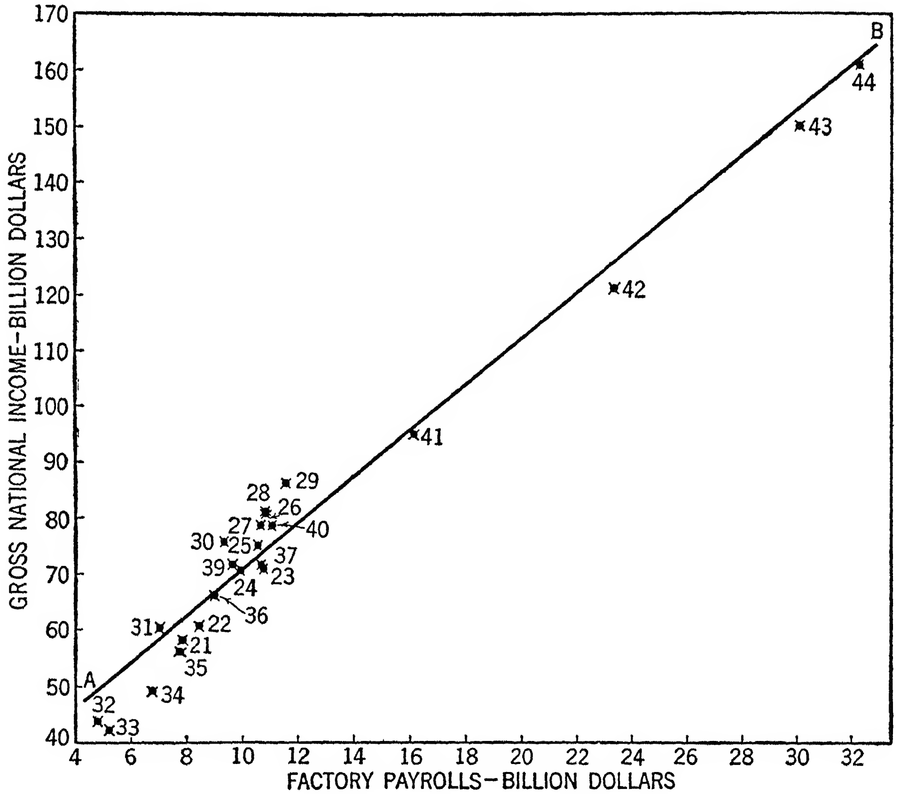

CHART 143. Gross national income and factory payrolls, by years, 1921 to 1945; also line AB of average relationship.

this number. But with national unemployment ranging between 9 and 10 millions from 1938 to 1940, only a fraction even of the 350,000 were able to migrate. In consequence, several million workers were dammed up back on the farms, for the most part not so much unemployed as underemployed. From 1940 to 1944, around 3,260,000 males over 14 years of age and 1,900,000 females over 14, joined the armed forces or migrated from farms, and still agricultural output was increased a third. The farm population of the United States declined from 30,269,000

to 25,190,000 between January, 1940, and January, 1945. If earnings per worker in agriculture are to be maintained somewhere near the levels relative to those of nonfarm earnings that prevailed in 1942 to 1945, not only must farm population be held at present levels, but it must decline further in the next decade. Only high-level urban employment will make this possible.

THE COST POSITION OF AGRICULTURE

The course of agriculture in the Western world has been a race between market expansion and the expanding output resulting from continued advances in technology. It is always a question whether markets can be expanded rapidly enough to keep prices from falling below levels which will give farm families a return for their labor and investments comparable with that obtained in other sectors of the economy. Although the picture is clouded by a number of other disturbances, such as the general depression and rising world tariffs, it appears that the increased output of United States agriculture resulting from the shift from animal to motor power, the adoption of hybrid corn, and similar improvements from 1930 to 1940 would have outstripped market expansion even under favorable conditions. And there is little basis for thinking that technology will not lead in the next few decades.

We have already pointed out that industrial production tends to be adjusted to market demand at fairly stable prices which cover long-time average costs. Because of their high variable costs, most corporations have found it more profitable to adjust their production as necessary in line with market demands at administered prices rather than to continue full production and allow free competition to set the price. Individual farmers, we pointed out in Chapter XX, can lower their costs as prices fall only to the extent that variable costs can be reduced. Because of the rapid changes in technology in agriculture, the most effective way for most farmers to reduce their costs per unit of output is to expand their output. This may be done by using more fertilizer, or better-balanced rations, or improved strains of seeds, or better breeding, or improved machines which both economize on labor and increase the volume of products marketed from a particular farm. Even if conserving the soil is a major object, the experience of most Midwest farmers with soil conservation plans for their farms is that these expand the farm output rather than contract it. Almost the only variable expenses for agriculture as a whole which can be reduced when market prices fall are supplies such as motor fuel, fertilizer and insecticides, and hired

labor. These items are only a small part of the long-time average costs, and farmers already using optimum amounts of these supplies can lower their costs very little. Thus when market supplies are burdensome, the individual farmer's solution to his cost-price problem is often to increase his market supplies in an effort to lower his unit costs.

Industrial labor, finding itself at a similar disadvantage when each worker contracted individually with their employer, turned to collective bargaining. Labor unions and employers have not yet learned how to use the new techniques of labor-market pricing without considerable inconvenience and injury to the public, but most people endorse collective bargaining as a distinct step in the labor-pricing field. Agriculture's first collective efforts, in the form of government-sponsored cooperatives, were futile. It has now turned to direct collective action through government programs.

DEPENDENCE ON FOREIGN MARKETS

The demand for the farm products of this country has always been in considerable measure foreign as well as domestic, and will continue to be so. On paper, our imports of agricultural products may exceed our exports, but the imports are mainly of products that cannot be produced at all in this country — like bananas, coffee, cocoanut, chocolate, palm oil, jute, and the like; or which can be produced in the continental United States only at a very high cost — like tea, silk, and hemp, and until recently, rubber; or for which the acreage of well-adapted land is limited relative to the demand for the product — like sugar cane, wool, flaxseed, tung oil, olives, and pineapples. Some of these, of course, like sugar cane and pineapples, are produced in our island possessions and enter our markets free of any import duties. This country could grow its own supply of tea. Back in 1870 to 1900, many thousands of the plants were brought into this country by the Department of Agriculture and its predecessor. The limiting factor is mainly the high labor requirement — higher even than cotton grown on a one-mule farm. If the domestic price had been raised high enough by import duties, however, tea would have competed successfully with cotton. Similarly, import duties on wool, sugar, and flaxseed could be raised high enough to make it profitable for our farmers to grow all of these that our people would consume at those prices — which would be much less than they consume now. These products would be grown on land which is now being used for other farm products for which their climate, soil, and location are better fitted.

The farm products which we normally exported before the war — cotton, wheat, pork and lard, evaporated milk, some types of tobacco, apples, prunes, and raisins — are those for which we have land so well suited that it is able not only to provide all that this country will consume at prevailing domestic prices, but also the importing countries in competition with other exporting countries. The United States contains a large fraction of the best cotton and corn land on the earth.

Some of the food- and fiber-deficit countries, however, try to produce as much as possible of their supplies of these at home, and like the United States, impose import duties to that end. This raises the prices of these to their consumers and lowers by a little the prices in the exporting countries. Wheat was around $2.00 per bushel, and sugar around 15 cents a pound, in several European countries in 1935–1940. Import duties were generally increased sharply in Europe from 1929 to 1935, as a way of checking the price declines that set in with the world-wide depression of those years. Desire to be self-sufficient in case of a future war was a factor in these increases mainly only in the sense that these countries felt that they did not dare let their agriculture decline. The United States led the way in this movement by raising its tariff duties sharply in the Hawley-Smoot Act of 1929. That the raising of these import duties had a pronounced effect on the agricultural exports of the United States is evident in Chart 144. The agricultural exports of 1937–1939 were 40 per cent under those of 1925–1929; likewise those of cotton; those of lard were 75 per cent down. Furthermore, agricultural exports had already begun to decline in 1925–1929.

The effect of the loss of export markets in the agriculture of the United States is made clear by Chart 145, which shows the relation between the volume of United States agricultural output and the size of its agricultural income, in two periods; 1910–1919, when exports were high, and 1934–1940, when they were low. The farm income figures in this chart have been adjusted for changing prices, and production is expressed on a per-capita basis to allow for the growth of the population. Adjustment has also been made for the unemployment and reduced buying power of 1934–1940. The farm incomes in the chart are what they would have been if nonfarm income per capita had been the same in all years. In the recent period, agricultural exports were only 6 per cent of our production; in the earlier period, 13 per cent of it. Going up on this chart means more farm income; going to the right, more farm output. There is no escaping the fact that the farmers were much worse off in the thirties when they did not have much of a foreign market. Their incomes were much less than in all the years from 1910 to 1919 except 1916 and 1917.

The next thing to notice in the chart is that in the period 1910–1919, the larger the output generally the more real money it brought. The peak-year output of 1912 sold for a fifth more than the small output of 1916. In those years, it was more than safe to expand our agriculture. It yielded big dividends to do so. But after 1934 this was not true any more. The year 1940 had the largest crop in this period. But it did not sell for as much money as the short crop of 1936. One could not honestly say to the farmers of the country in 1934–1940: Go ahead and produce all you can; the more you produce next year the more money you will

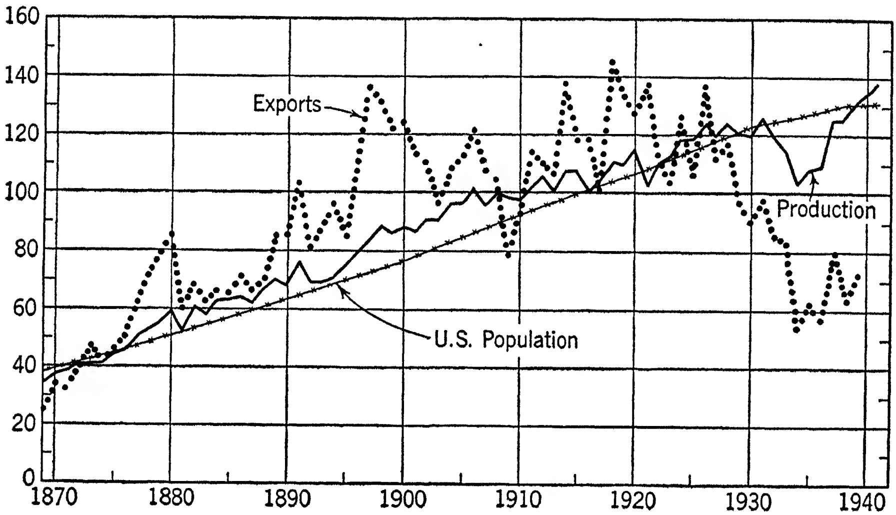

CHART 144. Index number of the physical volume of agricultural production and of exports of farm products; population of the United States; 1870–1940.

get for it. What actually seems to have happened is that the large outputs sold for about the same money as the smaller ones. But since the costs of the larger crops were more, the net returns to the farmers were less.

If the stretch of years from 1920 to 1933 had been put in the chart, they would have appeared in a halfway position between those of the periods before and after — with incomes ranging mostly 115 per cent of those of 1926, and with their general direction sloping upward gently. We were still in the foreign market in these years with farm exports equaling 11 per cent of agricultural output.

As for the war years, they appear to the right in the chart with the largest outputs in our history, and also with near the top incomes. In other words, in these years, we were pretty well back in the pattern that

prevailed in 1910–1919. The year 1941 was halfway back into this pattern. Everything was just as one would have expected. Our lend-lease shipments and greatly increased military demands took the place of our former export outlets.

How much in the way of foreign outlets for its farm products this country will be able to retain will depend upon how successful the United Nations Organization, and particularly the Food and Agricultural Organization, are in arranging with food-deficient and fiber-

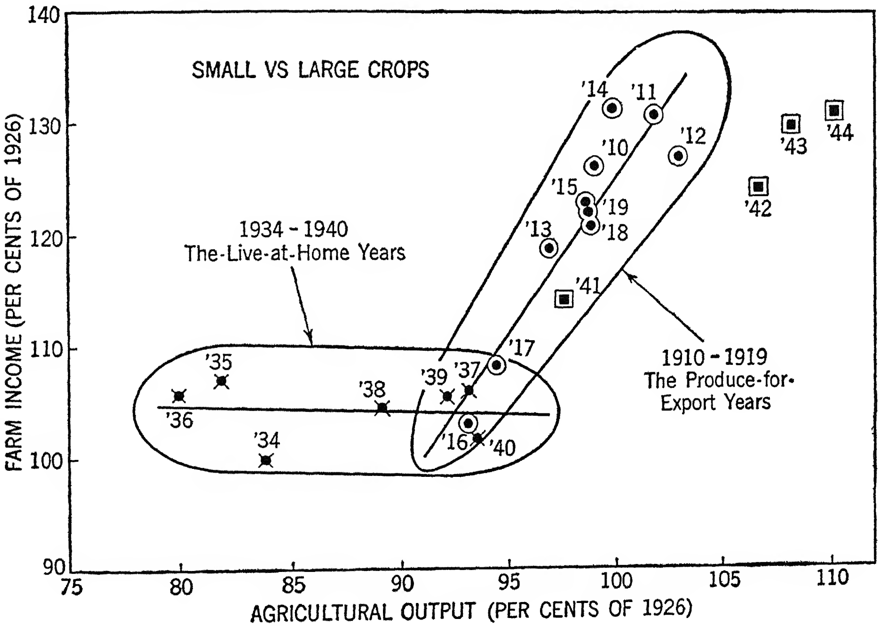

CHART 145. Effect of large and small agricultural output in two periods, 1910–1919 and 1935–1940, and in the war years.

deficient countries to have them accept our cotton, wheat, and other exports, and the exports of other export countries, and upon what arrangements the United States and the other export countries are willing to make to accept the nonfood products of these other countries in exchange. The more of such trade that can be arranged, the higher will be the level of well-being of the peoples in both the food-deficient and the food-exporting countries.

WHAT SHALL THE NATION PRODUCE?

In several earlier chapters in this book, and particularly in Chapter XVI, we considered the question of what is best to produce in any

particular area, and on any one farm. The statesmen of any country, in arriving at a decision as to what food products their country should produce, should look upon it as if it were one large farm. They should ask themselves, if the question is whether to grow all our own flaxseed, just how will this affect the receipts of the people of the nation, and how will it affect their expenditures. There is no doubt that it would increase the receipts of those who are now growing flaxseed. Most of those who shifted from wheat or other grains to flaxseed would also have larger receipts. On a large fraction of these farms, however, the increase in receipts from the sale of flaxseed would in good part be offset by reduced sales of wheat and the other products replaced by flaxseed, and it would be offset in some measure on all of them. The reduction in output of wheat and other grains would raise their prices slightly, and hence their receipts. Handlers and processors of flaxseed, and their employees, would also make larger incomes, although part of this would only be a shift from other sources of income. On the expenditure side of the account would appear the higher prices paid for paint and other linseed oil products by every user of paint in the United States, including the higher house-rents made necessary. The five million or more farmers not selling flaxseed but buying paint might pay enough more for this paint to offset the net gains in receipts of the flax growers, so that even the balance sheet for agriculture taken by itself would show that shifting to more flax would be unwise, just as shifting to more tobacco or peanuts might prove unwise for a single farmer on his cotton-tobacco-peanut farm in Georgia. The balance sheet for agriculture as a whole might, on the other hand, show a net gain; the flax growers would gain more than the other farmers lost.

But the final decision must be made in terms of the whole nation, not just its agriculture, and on this basis, a net loss would almost surely appear. The final decision might still be to support flaxseed prices at a higher level, by tariffs or otherwise. The statesmen might conclude that although it would cause a reduction of $25,000,000 in the national income, this would be desirable as a relief measure for farmers in the flax-wheat areas during a period of emergency; or might favor it as part of a general measure for subsidizing all agriculture in a period of depression. In some situations, the reason might be to help the farmers shift to a line of production that will stand on its own feet once it is well established; or to encourage a program of soil conservation. *But they should know what it is costing the nation to do these things.*

The simplest and most direct way to discover these costs is *to set up national budgets of receipts and expenditures with alternate production programs*

to see which ones maximize the national income, and what the cost to the nation is if one which yields less than the maximum is chosen for other reasons. Such budgets have come into use in recent years to determine the economy of public improvement measures.[2] They have a much wider field of usefulness in determining what lines of production to promote in a country.

PLANNING NATIONAL AGRICULTURE PRODUCTION PROGRAMS

World War II presented an unusual opportunity for the nations engaged in it to plan production programs in a rational way. The objective was clear-cut and visible for all to see — to produce the maximum amount of foods and fibers of the kinds that would contribute most to winning the war. The program makers began with a list of the foods and fibers needed and the amounts of each which were needed. They matched these needs against the available resources, and adjusted them in some measure to fit these resources. The resulting estimates were the *production goals*. The next step was then to break down these goals by areas and counties by finding which areas and counties could produce each of the products to best advantage, and how much of its land and labor it could use to best advantage in producing these products. The final result was a national production program so designed as to devote all the food- and fiber-producing resources of the country to their most productive uses. The result was an amazing increase in output.

In contrast to this wartime program is the one developed in this country following World War I, and culminating in the final phases of the A A A program in 1939–1941. World War I created an emergency in agriculture just as did World War II. A Food Administration was set up to handle it. It established minimum price guarantees for wheat, and promised to maintain a favorable hog-corn ratio. It expanded the county agent system to cover all the counties. Major emphasis was thus placed on educating farmers for increased food production. Out of this experience came our present permanent extension service program for carrying adult education to all rural people. Production expanded, especially of the export types of products, and the foreign-trade position of the country shifted. Before the war we had been a debtor nation, needing to export goods in excess of our imports to make interest and loan payments. During the war period, we exported enough goods to pay off our borrowings and make loans in addition.

[2] National Planning Association, Planning Pamphlet 47, 1945.

The sharp break in farm prices in 1920 was a part of the general post-war recession, but it was more than this. Farm product prices declined more than other prices, and especially the prices of the export products. Chart 144 shows clearly, first, the sharp break in the exports at that time, and second, the downward trend in exports over the decade. The depression, as a business depression, was over by 1923, but farm real-estate prices continued their decline. The efforts of Congress to cope with this situation mainly took the form of marketing and price adjustments. The legislation passed had to do with control of the farmer's markets, with cooperative marketing, and with credit.[3] The annual outlook program begun in this period, as explained in Chapter XXXV, was an administrative development under the leadership of the Bureau of Agricultural Economics, in which the extension services of the states participated. It never received any legislative support. Congress busied itself mainly with proposals for "making the tariff effective" on export farm products, which were embodied in the McNary-Haugen bills, twice passed by Congress, and twice vetoed by President Coolidge. The intent of these was to raise domestic prices of the major products above world prices by the amount of our tariff on them. The sponsors of this legislation believed that one of the main difficulties with agriculture during the 1920's was the inability of farmers to benefit from tariff protection as did industry.

It was during these years that the substitution of tractor for horsepower became important, ultimately releasing around forty million acres of land to grow feed for dairy cows, hogs, poultry, and other productive livestock. The commercial hatching and artificial brooding of chicks also made great progress during this period. Total agricultural production in the United States increased about 10 per cent during this decade in spite of the somewhat unfavorable price relationships.

THE FEDERAL FARM BOARD The decade of the 1920's closed, however, with the assurance that political action would be taken in the near future. Hoover had committed himself during the election campaign to the support of a federal farm board which would sponsor national cooperative marketing associations for marketing the different farm products, and also stabilization corporations for carrying the surpluses of large crops from one year to the next. The cooperatives were also to be financed in the temporary withholding of supplies from the market in the interest of stabilizing prices. Since the seasonal or other temporary

[3] The Packer and Stockyards Act, the Capper-Volstead Act, the Intermediate Credit Act, the Cooperative Marketing Act.

As an adjunct of the production control, "non-recourse" loans were made to growers of cotton and corn in the fall of 1933, at prices above the prevailing market prices, 45 cents a bushel on corn, and 10 cents a pound on cotton. If the prices did not rise to these levels by the end of the loan period, the government was to accept the cotton and corn in lieu of payment of the loans. This was the beginning of the commodity loan and price support program which has now become more important than the adjustment of production.

Another part of the A A A program provided marketing agreements as a way of raising the prices of dairy products and fruits and vegetables. Whenever a large majority, such as two thirds of the processors and distributors of a given commodity, were able to agree on the terms of a marketing agreement, the Secretary of Agriculture stood ready, by the use of his licensing power, to bring all the trade (and thus in effect the whole product) under the terms of this agreement. These agreements could be used to divert a part of the product into a lower use, thus maintaining a higher price for the bulk of the product and increasing the returns to producers. Most of the large fluid milksheds entered into these marketing agreements presently, and some of the fruit producer groups.

The federal government had at the same time taken over a major share of the responsibility for relief. This made possible a coordination of surplus disposal and relief distribution programs — funds available to the A A A could be used "for expansion of markets and disposal of surplus products" at the discretion of the Administrator. Pork, butter, and wheat were soon purchased as a way of supporting their prices, and then distributed through relief channels. In the later years, these purchases for diversion into relief were more widely extended, finally totaling $118,000,000 in 1940.

In 1934, the first full year of the acreage adjustment programs, the Midwest suffered a severe drouth. The corn yield for the United States fell off one third, and cotton yields a fifth; and 1936 was another year of drouth. The corn carried over by the corn loans in the fall of 1933 was all needed, and in the summer of 1934 every effort was made to grow feed on the land taken out of corn production. Accordingly, only moderate adjustment programs were undertaken in 1935. The second drouth in 1936 made necessary a further liquidation of livestock and reduced feed supplies far beyond the level believed desirable. These drouths greatly obscured and overshadowed the adjustments induced by the Adjustment program.

When the Supreme Court, in January, 1936, decided that the original A A A legislation providing for the collection of processing taxes, and

individual grower adjustment contracts, was unconstitutional, the Adjustment program was reoriented toward shifting land into "soil-conserving" uses — that is, from intertilled crops such as cotton and corn into sod crops for pasture and hay. Farmers were not offered contracts, but if they grew acreages of the various crops which fitted the diversion requirements of the program, they were eligible for the substantial benefit payments. The quotas were now expressed in terms of quantities of product obtained from stated acreages at *normal* yields. The amount of diversion from historical bases required in order to obtain benefit payments was in part determined by expected market demands and in part by the need for soil conservation. The program tended each year after 1936 to become more specific in terms of adjustments of particular crops, and to place more emphasis on soil-conserving practices, such as legume seeding, use of lime and phosphate, strip-cropping, and the like. The other supplementary programs, such as commodity loans and surplus diversion activities, were continued and in many cases expanded in the years immediately preceding the war.

Estimating the effects of the A A A programs is made difficult by the drouths of 1934 and 1936, and several other developments. Probably the greatest financial benefit to farmers was the increase in income they received in direct government payments. Incomes were further increased by the commodity loans, the surplus-diversion purchases, and in more recent years, by the continuing benefits of the soil-conservation practices of earlier years. Total agricultural output was not affected much. The increase in yields per acre in the last four years of the acreage-control programs about offset the reduced acreage except in the case of cotton. Corn yields averaged 29 bushels in 1937–1941 compared with 25 in 1927–1931. Cotton yields increased from 171 to 246 pounds in the same period; and tobacco yields from 770 to 937 pounds. These increased crop yields came from more use of hybrid seed corn, from the use of improved machinery for seedbed preparation, from freer use of fertilizers, and from the concentration of the smaller acreages of the crops on the better lands.

But although total agricultural production was influenced very little, the distribution of acreage between crops was affected somewhat more. Thus as we noted in Chapters XI to XIV, the shift to soybeans in the Corn Belt was stimulated greatly. Most important of all, adherence to the historical bases stifled competition between areas and sustained production in areas that were increasingly at a disadvantage. Thus, the Delta and the Texas High Plains cotton areas were more or less checked in their supplanting such areas as those in the old Southeastern cotton

states and the Rolling Sand Lands in the nation's cotton markets. The adherence to A A A historical bases continued more or less in the first year or two of the war, but by 1945 corn acreage had risen to 92,229,000 from 87,631,000 acres in 1941; wheat to 68,808,000 from 62,332,000 in 1941; and tobacco to 1,821,000 from 1,306,000 in 1941. Cotton acreage had declined in 1945 to 18,355,000 acres from 23,130,000 in 1941, but this was due in part to the shortage of labor.

The method used to shift production in the desired direction during the war was that of supporting prices at the level which it was deemed would call forth the volume of production sought. For the basic non-perishable products, the method employed to support prices was that of loans to farmers at the support price. The use of loans had been begun in 1936, but only at 52 per cent of "parity." By 1939, these loan rates were raised to 85 to 90 per cent of parity. Finally, in July, 1941, Congress passed the Steagall Amendment, which directed that support prices be applied to all products urgently needed during the war, such as live-stock products and meats, soybeans, peanuts, peas and beans, and flax. Then in the fall of 1942, Congress made it mandatory for the Secretary of Agriculture to support prices of basic commodities at 90 per cent of parity for two years from the first of January following official proclamation of the end of the war. This provision was intended to give farmers assurance that prices would not collapse immediately after the war, and thus encourage them to make the necessary shifts to increase production to the utmost. By 1944, all direct production adjustment programs had been dropped, support prices alone being relied upon to stimulate the production needed.

It follows from the foregoing that in 1936–1941, the distribution of crop acreage was being determined importantly by marketing quotas set according to historical bases, without any close relation to comparative advantage and economy in production; and in the latter half of the war, much more largely according to such advantage and economy. *The conflict between these two procedures must be reconciled in the postwar decade.* The nation's agriculture, and the general economy, will prosper most if production goals can be set up on the basis of probable domestic and foreign needs, and production can be distributed between regions and areas in such a way as to promote the best use of the nation's food- and fiber-producing resources. The only good alternative to planning in this way, is to take away all controls of every kind and let prices and production adjust themselves at whatever level would come to prevail. This alternative is surely preferable to any planning and controls that tie production to some period ten to thirty years in the rear. The adjust-

ments that will be made without any controls need not, however, be unguided. Producers can be supplied with the fullest possible information as to trends, cycles, and outlook, and even assisted in planning their individual farm businesses.

INTERNATIONAL MEASURES

In similar manner, if controls are going to be exercised, the peoples of the different nations will be best fed and clothed, and will have the most income left over to buy housing, health, and education, if they can, by planning on an international basis, set up over-all production goals for the major foods and fibers, and then agree upon what contribution to these goals will be made by each nation. Surpluses of any crop arising from high yields can be put into international pools to make up the deficits of some countries in the year following.

If international measures relating to food and agriculture cannot be made to work out to such ends as these, it would be better for the nations to undertake no controls whatever, and to let international economic competition establish production and prices, guided, of course, by the fullest possible information as to world production, trends, cycles, and outlook.

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